A MANUAL

OF

THE PROCESSES OF WINDING. WARPING AND QUILLING

of Silk and Other Various Yarns from the Skein to the Loom

BY

SAMUEL KLINE

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PREFACE

THE purpose of this work is to place at the disposal of the beginner, in the mill, a practical handbook on the processes of Warping, Winding, Doubling and Quilling of silk yarns, and to put before the Owners, Managers, Foremen, and Operatives of Silk Mills, the fruits of an experience in these departments stretching over a space of many years. It is the earnest hope of the writer that this manual will prove to be of special value in this field, inasmuch as no attempt has ever before been made, in this country, to bring out a reference book embracing such detailed statements of the technique of these branches of textile manufacture.

The matter in this book is based upon a long and practical mill experience, supplemented by much special study, and every operation detailed herein has been actually done by the writer personally. This practical personal experience is here put before the reader to help him in dealing with the many troublesome details of his daily work.

The instructive value of these pages can best be realized by following the author from cover to cover, and this, if faithfully done, will afford to the textile worker those little, but invaluable, helps which otherwise could only be obtained by an actual experience of many years.

In these days of competition, the possessor of practical knowledge has the advantage, and it is from the ranks of the practical men that foremen and managers are invariably taken, which positions are a long step towards ultimate mill ownership.

The textile industry, outside of silk manufacturing, is rich in the matter of well-written and carefully-prepared technical literature, but, in many of these works, the subject is approached from a far too general viewpoint, though there are some books

which deal carefully and well with special subjects. The technique of Winding, Warping, Doubling and Quilling is, however, as far as can be ascertained, a subject on which little or nothing has been written of such a detailed character as would be of practical service to the mill operative.

While realizing that there must be many shortcomings and omissions in such a work, the writer, in placing it before the public, does so in the full confidence that the detailed and comprehensive instructions set forth will be of real value to all interested in the subject.

He takes pleasure in expressing his sincere thanks to those friends in the trade who have assisted in the compilation of the book, and particularly to Mr. James Chittick, of New York, Consulting Textile Specialist, who has carefully revised the matter contained herein, and made many valuable suggestions and additions.

SAMUEL KLINE.

96 PROSPECT STREET,
JERSEY CITY, N. J.

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LIST OF ILLUSTRATIONS

ERRATUM

Page 29, 15th line. *For*

$160 \div 10$ inches $= 5$ ends and 10 overs

Read

$160 \div 30$ dents $= 5$ ends and 10 overs

WINDING, WARPING AND QUILLING SILK

CHAPTER I

MATERIALS AND THEIR CARE

The Treatment of the Different Materials and their Care

When materials are received by the various departments in the mill, they should be immediately checked up and placed in a stockroom, or other suitable place that is properly equipped with closets, shelves and drawers, which should be plainly numbered. Good light is essential, but all materials should be covered and protected from the light when not actually in use. A permanent place should be assigned for each lot, avoiding as much as possible the crowding together of lots that are similar in color, size or texture.

A label, or stock ticket, containing detailed information, which varies in different mills, should be attached to a bundle of each lot received. This is known as the "original ticket," and should contain the following items:

STOCK TICKET

Dye Lot Number.....
Date Sent to Dyer.....
How Dyed (pure, weighted, fast, etc.) .....
Weight Sent to Dyer.....
Number of Bundles.....
Number of Skeins.....
Size of the Yarn.....
Weight Returned from Dyer.....
Date Returned from Dyer.....

Each of the other bundles in the lot should have a smaller ticket attached, which contains the lot number, size and color. The original should not be removed from the lot until it is entirely consumed.

It is preferable to use different colored tickets for the various materials, as it is then easier to distinguish them and lessens the liability of making costly mistakes.

Each lot should be weighed when received, and the rolls and skeins counted. After comparison with the lot ticket, and being found to be correct, these items, and all other details, should be recorded in a loose-leaf book or card index, kept for this particular purpose, the lot passed upon by the person in charge, and placed in its allotted shelf or closet, properly covered, and with ticket facing outward.

CHAPTER II

WINDING PROCESSES

Winding Machinery

THE winding machine is for winding skeins of yarn onto bobbins. There are several different patterns of winding machines, which equipment is usually made to order to suit the requirements of the work in the mill.

Some machines are built of both wood and iron while others are constructed entirely of iron, with the exception of the kneeboard, guider rail, and bobbin shelf.

Winding machines can be made of any size and length and possess any number of spindles, so as to bring about desirable economy of floor space.

The standard spindle is 6 inches long, but the length may vary according to the pattern of the machine.

The ordinary winding machine possesses a traverse motion that spreads the material evenly and uniformly from side to side of the bobbin as it unwinds from the skein.

A double number of spindles can be added to the machine by making it double-decked, with two rows of swifts on a side, one above, the other below.

In using a double-decked winder, there is a saving of one-half the amount of floor space, with a saving in the corresponding expenditures for heating, lighting, attendance and power required. The operative can attend to twice the number of spindles in a given space. As the cost per spindle of a double-decked machine is less, there is a further saving of interest and depreciation on the machines themselves, and also the saving of the rental, etc., for the space occupied.

There are, however, several disadvantages to a double-decked machine, as, for instance:

1. Operatives seldom care to work on them.

2. Short operatives have a certain disadvantage, as the reaching and eye-strain is often tiresome.

3. On the upper deck, the skeins run the reverse to those in the lower row, which makes it a difficult task to find the lost ends.

4. The ends sticking in the skein are the cause of spindles of the upper deck being pulled from their bearings.

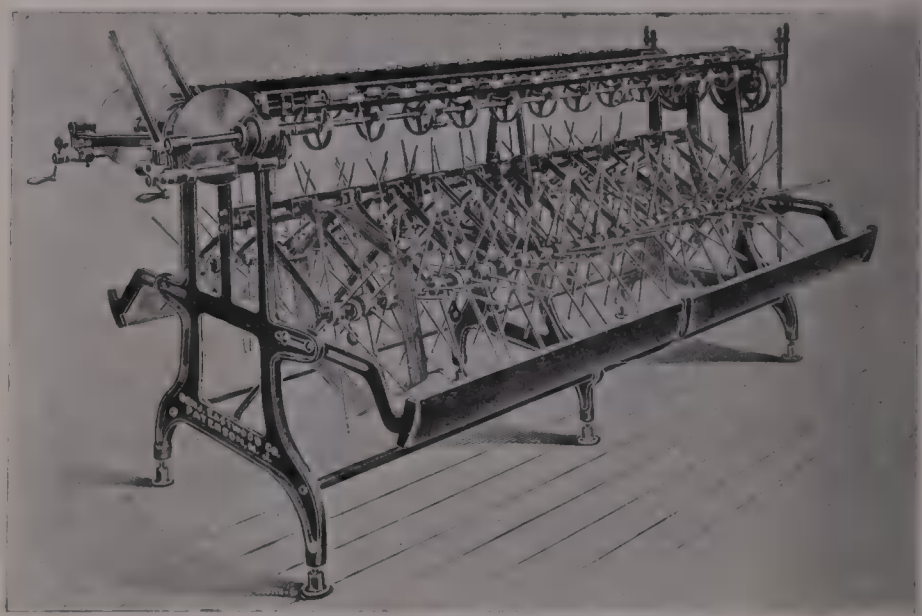


FIG. 1.—Variable Speed Winder.

5. The broken ends of the skeins from the upper deck are often wound on the bobbins of the lower deck.

6. Waste falls more easily from the upper deck onto the lower bobbins, causing poor work, and damages wound materials.

7. The tension of the skeins on the upper deck is not as uniform as on the lower deck.

My opinion is that the disadvantages materially outweigh the advantages.

Winding Machine Space

The floor space required for a winding machine depends largely upon the make of the machine used and the size of the swifts,

the kneeboards must be extended to fit the swifts. The aisles between the sides and ends of the machines should measure at least 2 feet, and 2 feet 6 inches is preferable.

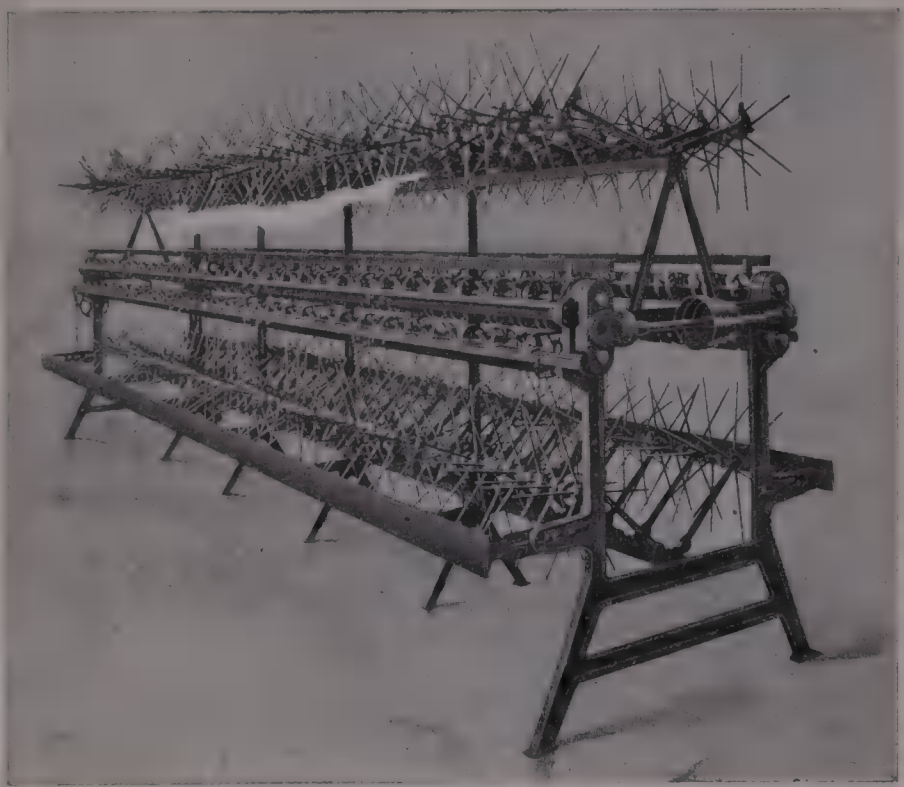


FIG. 2.—Double-deck Winding Machine.

Winder Swifts

There are several patterns of swifts made and supplied with the machines, those most commonly used being made of hard or soft wood according to the usage to which they are to be put.

The size swifts used for wool, and raw or hard-silk winding, are larger than those used for organzine, tram or cotton. It may be here explained that hard silk is raw, or thrown, silk from which the natural gum has not been removed.

Soft silk is silk from which the gum has been boiled out.

The standard swift is made with twelve spokes, six spokes in

each side of a wooden hub. The smallest and lightest swift is used for soft silk and artificial silk and measures 17 inches across. The cotton swift measures 19 inches across, and that for raw or hard silk, and wool, 25 inches across.

The hub of the swift has a pin axle on each side, to hold it in the bearings and brackets of the winding machine. The pin causes the swift to revolve readily and smoothly and balance easily.

Swift Braces

Braces are usually made of cotton braid or banding, and the best are endless and spliced so that they are entirely free from knots. These will give better service than knotted braces and are usually stronger and cleaner and do not tear the ends, as is often the case when the knotted brace is used.

The endless brace does not stretch as readily, and very often can be washed and used over again. While these are the swift braces most commonly used, there are also braces fashioned of metal, fibre and rubber.

Good swift braces are of the first importance if the best winding results are to be had. The cotton-banding swift braces are serviceable when new, but soon become slack at one side. To tighten them, the operative will give a turn round the spoke which pulls the spoke out of shape, and many times breaks it, and, in this way it does not take long for many of the swifts in a department to get into bad shape, with a resultant increase of waste and loss of product. After use on dark colors, such braces should not be used for light colors without washing, as they are easily soiled and become sticky from handling. They also entangle the loose ends, and waste catches in them.

The braces made of a single strand of cotton banding with loops made by making an eye splice at each end of the band, are largely used. They slacken in time, and are tightened, or shortened, by twisting, but, to give them firmness, a considerable strain must be put upon the sticks themselves. These also get dirty and sticky.

Swifts made of plaited wire, and wire in other forms, are not infrequently used, but are, in a degree, subject to the same difficulties as cotton braces.

After long experiment, I succeeded in developing the fibre brace, of which a picture is presented herewith. These are made of very high grade fibre board, about $\frac{1}{32}$ inch in thickness, and shaped as shown in the illustration. They are very rigid, and extremely durable. Since developing this brace, I have made many thousands of them and have used them for a number of years, and consider them immensely superior to other swift braces for the following reasons:

1. They can be used on all sizes of swifts in which are round-tapered spokes set slanting out from the hub, as the spring of the spokes will hold the braces tightly, and in place, though they can be slid up and down freely, and they hold the skein in a true and good circle. Light, strong, and durable, they will not wear out, and do not soil and rust as do wire braces.

2. They increase the winding output.

3. Considerably less waste is made.

4. They strengthen and support the spokes of the swift, preventing them from getting loose in the hub.

5. They keep the skeins spread flat, straight and smooth, and in the same shape as when reeled.

6. In the long run the cost is distinctly less, for though the initial cost is greater, yet the wear upon them is negligible, and they last indefinitely.

I would strongly urge the general adoption of this brace.

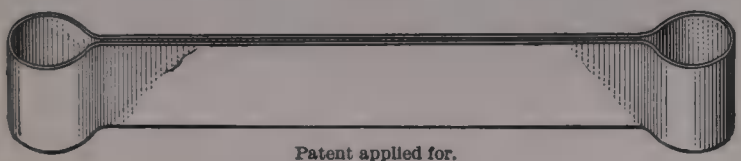


FIG. 3.—Fibre Swift Brace.

Iron Tension Weights

These are of various sizes and are used to give the necessary tension required for the different sizes of materials that are being worked. By their use, the yarn is wound on the bobbins with a uniform tension, being neither too hard nor too soft.

Tension weights are made with hooks on one end so that they

may be attached to the center of the hub of the swift. Four, eight, sixteen, and thirty-two ounce weights are generally used.

Spindles

There are many different makes of spindles; some are fashioned with iron-pulley heads and others are made of wood. Spindle bars are made of iron, with lengthwise grooves so that a steel-wire spring can be inserted which holds the bobbin and prevents it from slipping when in motion.

The use of wooden heads has proved more satisfactory for winding operations on silk and the finer materials, while iron heads are generally used for the coarser yarns.

Guiders

Guiders made of glass, porcelain and enamel, in various shapes, are used to deliver the ends of the material that is in process of winding to the bobbins, and are so adjusted to the guider rail that they can very easily be shifted from side to side, as may be required, so as to act in conjunction with the traverse bar. The motion of the machine causes the bar to move regularly from side to side, within the required limits, thus distributing and spreading the threads evenly and uniformly onto the bobbins.

Power and Speed for Winding Machine

Very little power is required for driving winding machinery. Fine and tender materials require very slow speed, while strong and coarse material can be run at a very much faster rate. There is not any fixed or standard rate of speed for winding operations. It has been found that slow speed will improve the winding of some classes of yarns, whereas strong material can be wound at high speed and the production correspondingly increased.

The speed can easily be changed and regulated to suit the material in process of winding by shifting the belt on the step or cone pulley, or regulating the friction pulley. This regulates the drive of the shaft, and keeps the pulley wheels and bobbin spindles revolving at any determined speed. This is called a friction motion

and is highly desirable for the successful winding of silk yarns and other delicate materials.

Winding, in General

Proper winding is of the greatest importance in textile manufacture, as all yarns must be wound before fabrics can be manufactured therefrom. The object is to transfer the yarns evenly and rapidly from the skein state to the bobbins, working with

FIG. 4.—1. Skein parting and dressing pole. 2. Roll, and skein, of yarn. 3. Scale for weighing yarn. 4. Bundle of dyed silk yarn. 5. Mill basket, with empty bobbins. 6. Fibre mill box with wound bobbins.

such materials as silk, artificial silk, wool, cotton and other fibres that are used in the weaving of plain, Jacquard, and mixed fabrics.

Although the characteristics of the various yarns greatly differ, the treatment varies but little in the processes of winding, warping, doubling and quilling, but sharp attention is called to the fact that each material requires a wide experience to handle and humor it, so that the proper tension may be applied in the winding.

The winding of dyed soft silk is the most difficult, requiring not only skill, but long experience in such matters as the finding of lost ends, keeping the greatest number of swifts running, and making as little waste as possible of costly yarn. Operatives who have had a wide experience in the handling of raw or hard silk, and who, eventually, become soft-silk winders, and are thus familiar with the treatment of silk in its raw state and, after dyeing, are in a valued class by themselves.

Given what is known as good silk, and such operatives as outlined above, the result in the winding room is invariably excellent. But, with inferior low-grade silk to be processed, there will be constant trouble, even though the operative is an expert. On the other hand, a careless and unskilled operative can be the cause of endless trouble even with the best of silk.

Some female operatives adapt themselves very readily to winding, with all its peculiar and exacting details, and learn very quickly, becoming quite skilful in, say, from six months to a year. Others require two or three years to reach an effective point, and some never become really proficient.

In a large winding department, where there are many operatives and a great variety of sizes and colors are to be worked, the foreman should endeavor, as far as possible, in giving out silk to be wound, to select the operatives best qualified to handle the different lots with the least delay.

Each operative should be supplied with a box or basket, and clean paper to cover same, in which to place silk or other material to be wound.

Upon receiving a lot of silk to be wound, and before commencing work, the operative should check up the rolls and skeins with the lot ticket, and ascertain therefrom the number and description of bobbins to be used for the various sizes of materials to be worked.

The skeins of the rolls should be separated very carefully and each skein handled by itself. Great care should be taken not to break, tear or tangle the ends while parting the skeins to find the starting end that is always attached to one of the tie bands. This end is usually located on the outside of the skein, and the skein must be so placed on the swift that it will unwind from the out-

side, and in a direction away from the operative. After the skeins have been placed, by the operative, on the swift, and evenly adjusted, she then removes the tie-bands, unfastening last the one to which the ends of the skein have been attached, being careful to keep track of the position of the end that is to be wound.

After inserting a spindle in the bobbin, she attaches this end to it by winding it a few times round the barrel, but she should not tie it. The bobbin, with its spindle, is then placed in the spindle bracket, and the end is passed through the porcelain guide on the traverse bar. When the spindle is started, the thread will begin to unwind from the skein onto the bobbin, and the traverse bar, moving to and fro, spreads it evenly across the width of the bobbin, the winding being continued until it is full.

The silk on the bobbin should never be allowed to fill it higher than the circumference of the bobbin head, and, in fact, it is better not to fill it quite so full.

Good strong silk will wind without much machinery stoppage. An ordinary operative can easily keep 75 to 100 skeins of soft silk running. An inexperienced operative can very easily damage the best of silk by careless and rough handling and tangling, and losing the cross. Such operatives keep very few skeins running.

Then, again, there are a number of other causes for poor winding. Silk of inferior quality, or which has been damaged in the throwing or dyeing operations, presents unlimited difficulties in the winding. It can only be wound by a skilled operative and even then the production is so slow that the winding, at best, will be very costly. Never should such silk be given to an inexperienced winder as the results are invariably disastrous.

The amount of silk an operative can wind in one working day depends greatly upon the skill she possesses and the quality and state of the silk. Under normal conditions, with good silk (say $1\frac{3}{4}$ dram, $\frac{16}{18}$ oz., organ.) a fair operative can wind about 18 to 24 pounds in a ten-hour day. If the same operative is obliged to contend with inferior or damaged silk, in spite of the most careful handling, pounding, pulling, and dampening, change of tension weights and of speed of machine, and the many little humoring devices known to good operatives, from 5 to 10 skeins is all that can be kept running, and 2 to 3 pounds a day produced.

The general treatment in skein winding of other materials is about the same as for silk, although an experienced silk operative is not rated as a wool, cotton, or artificial silk operative, unless actual experience has been had. Some rapidly learn to handle all kinds of material, while there are any number of operatives now employed whose experience has been limited to one particular kind of yarn.

Be it well understood that every operative does not go about her work in the same way. It will be found that some are neatness personified. Cleanliness is an essential adjunct to good work, and it is often recognized in practice that, where the attendant is a person of neat appearance, better work is invariably found on and about the machine she is working at, as compared with another attendant of more untidy habits. For instance, this class of operatives will start their bobbins with great care, making sure that every end is fastened, **but not tied,** to a clean bobbin, and that each bobbin fills up evenly and is uniform in both tension and appearance. This class also take care to tie good knots, keep their ends running as much as possible, and keep their work and their clothing free from waste. Winders of this sort are valued employees.

There is another class of operatives who are careless and untidy. Their one idea seems to be to get the work off utterly regardless of how it should be done. Very often this kind of operative seems to work harder than her skilled sister, but she is a retarding element. With this sort of workpeople, ends are started on bobbins whether the latter are clean or not. Their bobbins are allowed to fill up on one side which leads to undesirable unevenness. They pay no attention to tension weights and so the bobbins are wound irregularly, some soft, others hard. They tie poor knots and considerable waste is found not only in their work but also upon their clothing. Such operatives, needless to say, because of the troubles they cause, should find no place in a well-conducted mill.

In the matter of knot tying, the ordinary loop knot is most commonly used and works very well with some materials, but this again is dependent upon the usage to which the yarn is to be put. In many winding plants the operative is called upon to tie

a special cross, or weaver's, knot, that does not open in the weaving operation, which sometimes happens with the loop knot when a difficult weave is being worked.

The only tool a winding operative requires is a pair of special scissors and this should be used to cut the ends when a knot is tied, instead of breaking them off as is often done by careless workpeople.

Oil and rosin should not be used on spindle heads and pulleys to prevent them from slipping, as it has been found that they do more harm than good. Rosin causes the spindles to become rough and lumpy, thereby causing them to jerk and produce end-breakage. Continued and persistent use of rosin causes the hands of the operatives to become sticky in manipulating the spindles. The only proper thing to use in this work is carpenter's chalk, as this gives the desired results and makes for cleanliness in the handling of materials.

An important point for the foreman to bear in mind is the speed at which the spindles should be run in winding the various classes of materials. If the machine is running too fast for the particular yarn in work, the ends will be continually snapping and too large a proportion of bad bobbins will be the result. If running too slow, the thread is apt to run on slack, which will cause soft bobbins and considerable waste.

Still another important point is the weighting of the swifts. Around the hub or center of each swift a weight is loosely hung, and which, if not of the right proportion or weight, will cause a great deal of trouble. If the swift is not weighted sufficiently, it will very often overrun itself, then again, if too heavily weighted, it will not run fast enough for the take-up of the bobbins. Both are faults which cause ends to break, and which eventually tell against the cost and production of the yarn.

If perfect work is to be achieved, every swift should run perfectly true when in its place on the frame. It must not run back in a contrary direction after having been once stopped. It should be adjusted so as to run to a dead stop. Many operatives have a very careless habit of throwing down ends haphazardly after they have tied a knot, which ends often get entangled in the swift, or wrapped around the spindles, filling and choking them up with

bits of fly ends and waste and so interfering with the smooth running of the swifts and spindles.

When, owing to circumstances, good winding is out of the question, such lots of yarns should be put through the various processes as cleanly as possible, but with no unnecessary waste of time. In most instances, if such yarns receive too much processing they will become rough and tender and cause trouble in the weaving operations.

In a plant where a large number of operatives are employed, loss of time and waste, caused by neglecting details such as have just been described, greatly increase the running cost, while if consideration is given them there will be a large saving of waste and time and, at the same time, the yarns will be in a much better condition when they reach the looms.

Sometimes, small lots are dyed for warps and ordered wound on a certain number of bobbins. Generally, such lots are given to the operative with special instructions, but in cases of this kind the operative very often cannot seem to get the same quantity of material upon each bobbin as instructed, for, in most cases, the matter is mere guess work on her part, and, consequently, some bobbins will contain more yarn than others in the lot.

This can be overcome in a measure by following the rule given herewith. The operative should ascertain the number of skeins to the lot, divide this by the required number of bobbins needed, and the result will give the number of bobbins to be wound from each skein.

Operatives who have not been instructed correctly as to just how to start the end of the yarn on the bobbin, have a most annoying and unnecessary habit of starting the end lapped and doubled, with a long end dangling, which snarls and causes the end to tangle and snap off, instead of running off clean. When the yarn, so wound, is handled by the warping operative, instead of running off clean, breakage and snarls ensue and considerable damage is done. The ends intertwist causing smashes and crossed ends in the warp, which, in turn, form waste and cause loss of valuable time in the warping department.

There are only two correct methods of starting the end in winding yarn on the bobbin. The first method is to hold the yarn

at the extreme end on the bobbin between the thumb and fingers of one hand and with the other hand give it a few turns around the barrel of the bobbin and so start the winding. The other method is generally used for the finer materials. The end of the yarn is wetted and placed so that it will adhere to the running bobbin.

By making use of either of these methods there will be no danger of the usual snapping or breaking off towards the end of the unwinding operation as the yarn will run off clean from the bobbin from start to finish.

Fastening or Securing the End on a Wound Bobbin

An important point connected with winding operations and to which attention should be given, is to make sure that the end of the yarn is properly fastened on the filled up bobbin, which does away with the unraveling and consequent entanglement of the loose end. If the end is not so fastened, considerable waste is sure to accumulate. Very often operatives, when fastening the ends on the wound bobbins, pull the end deep into the bobbin and break it off short. Consequently, when the bobbin is placed in work in the warping or quilling operation, the end cannot be found, thereby causing more waste and loss of time.

The end should always be broken off in such a manner that it can readily be seen, and no time be lost in trying to locate it. A good way is to leave the end long enough to be crossed over the bobbin.

Different Kinds of Knots

Properly tied knots are of the greatest importance, and require the attention of all operatives. There is not enough said or read about knots. If there were none to be made, I believe that half of the time of labor, half of the machinery required, in the whole textile industry would be saved. Every knot to be tied entails the stoppage of a machine.

The accompanying diagrams show the different kinds of knots, both open and closed. These are principally used in the processes of winding, warping, and quilling.

Figure 1 is a "square knot," and used only for special purposes.

Figure 2 is a "draw knot," used when splicing and tying broken warp threads.

Figure 3 is a "weaver's" or "cross knot." It is the safest and best and should have the preference over all others, wherever it can be used. It is the most solid and smooth, and also has the advantage of not slipping apart.

Figure 4 is the simplest, easiest and quickest knot that can be made. For that reason it is the most used, but it is not a safe one to make on the extreme ends of threads on account of its size, and it also opens easily and slips apart.

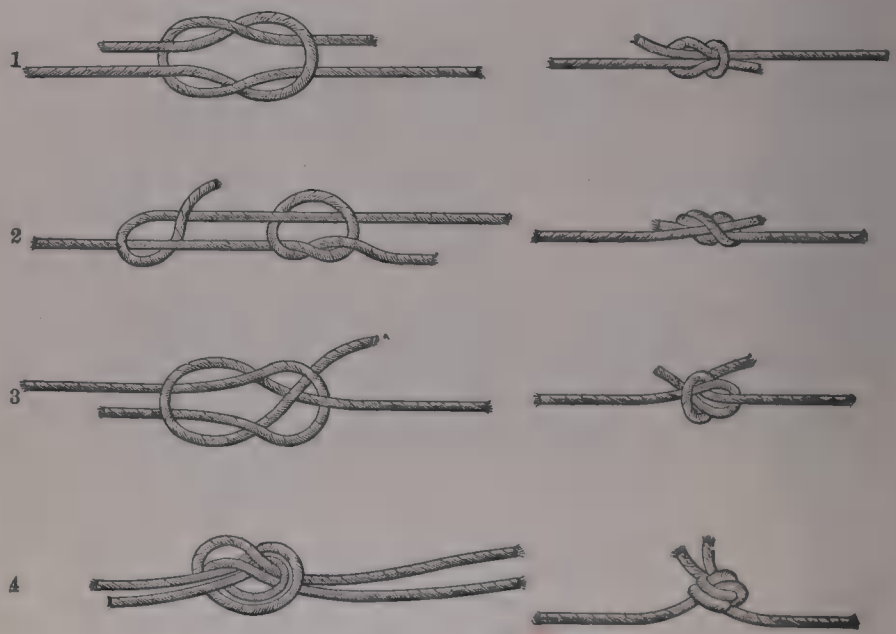


FIG. 5.—Different Kinds of Knots, Open and Closed.

Making and Tying Knots

All winding operatives should remember that the making and tying of good, clean knots is of the utmost importance. It is just as easy to tie a good knot as a poor one. A skilled operative will tie a perfect knot and use the scissors for cutting off the ends,

which should be one-eighth to one-quarter of an inch long, and this in about five seconds. Other operatives are very careless in this branch of work and do not seem to realize the importance of proper knot tying.

Some have the very bad habit of tying snarled and stringy ends and breaking them off with their fingers or biting them off with their teeth, instead of neatly cutting them off with the scissors. Such knots cause all kinds of trouble in the weaving room when they are carelessly made in the winding, warping or quilling operations. When one stops to think of the large number of knots which are really obligatory in processing yarns, it can readily be seen that perfect goods cannot be manufactured when knots are imperfectly tied.

Winding Coarse Material

When winding coarse material for filling, there should not be any knots tied in the event of the end breaking, as this would cause lumps that would give endless trouble in the weaving. There should be one continuous length of unbroken and untied threads upon the bobbin, whether it be full or only partly so. It is unsafe to lap two ends on one bobbin, as this generally causes loose and double ends in the quills, which, in turn, is sometimes the cause of ends being torn out of the warp, making costly smashes.

Mixing in the Winding Operation

It is very dangerous to give an operative materials of the same shade but of different sizes unless the sizes so differ that mixing will be easily detected. Giving mixed lots to operatives should be avoided as much as possible, but at times this cannot be avoided. In such cases the operative should be instructed as to the characteristics of each particular lot.

Careless Winding Operatives

Careless operatives will often allow the draughts from an open window to blow upon their work, which naturally deflects the ends of the material from their proper course, thereby causing defective work. Then again, they will carelessly drop pieces of material

cut from the long knots, which often are caught by the running thread and carried around the bobbin, or the swifts, thereby causing trouble.

Sometimes during the operation of placing the bobbins and spindles in the bearing brackets, the broken ends, picked from bobbins, will often catch and wind around the spindle bearing, moving it slightly from its position and so produce defective work. Winding machinery should be examined frequently and kept up to a high state of efficiency.

Winding Bobbin Stopper Device

A device to overcome the overrunning of bobbins should be attached to all winding machines, but, to the writer's knowledge, such devices are not furnished with the machines by the builders.

Touching on this point, the writer, many years ago, had a device specially made which has proved satisfactory and beneficial in winding operations on all classes of materials and which has been in use ever since.

The device is made of light cast iron, similar to an ordinary shelf bracket, with a short slot made lengthwise in the upright part. In the slot is inserted a small screw or bolt so that it may be attached to the winding machine, either on its wooden or iron parts. This permits the adjustment of the bracket so as to fit the required size of bobbin, which is accomplished by simply loosening the bracket and sliding it either up or down as the requirements demand. When the bobbin has received the proper amount of material it will touch the second half of the bracket and cause it to raise from the contact of the spindle pulley thereby stopping the bobbin.

This device can be so arranged as to fit any make of winding machine and eliminates all danger of the bobbins winding too full and running over, thus preventing unnecessary waste of costly material.

Tracing the Workmanship of the Operatives

In a mill where there are a number of operatives and large quantities of material of one size and color to be worked at the

same time, it is very important to use a carefully-planned system so that the work of each operative can be accurately traced. By the use of this method, imperfect workmanship can be readily discovered, and the operatives, on succeeding operations, can be cautioned.

There are a number of such systems in use. One is the pasting of letters or numbers on the bobbins; another is the making use of different-colored bobbins for each operative. The best and most reliable method is, perhaps, the use of narrow strips of different-colored tissue papers, about $\frac{1}{2}$ by 2 inches, placed lengthwise on the empty bobbins. One end of the paper should be left out and fastened in the space between the spindle head and bobbin, thus enabling the work to be traced as long as there is any yarn on the bobbin.

Artificial Silks

The writer has had a somewhat varied and exhaustive experience with the handling of artificial silk yarns and, therefore, is in a position to point out ways of overcoming the many difficulties to be contended with in the winding, warping and quilling of this commodity. Artificial silk yarn will not stand the machinery tension or strain as is the case with natural silk and other yarns. The artificial fiber should be well dried before the winding process is attempted. The best winding results are obtained by carefully opening the skeins and spreading them loosely on dressing poles made with stout wooden arms or pegs; then shake and smooth out the skeins by hard jerks with a stout, round and smooth wooden parting stick, so as to give them the proper dressing and parting. The parting stick should be placed in between the skein and be made use of to smooth and straighten it out, instead of using the hands, as it requires more strength to separate the sticky ends than the hands can supply unaided.

A light application of paraffine to the dressing pole, and the spreading of the skein and careful rubbing around the pole, will greatly improve the winding of sticky skeins, but the careless use of paraffine is apt to cause streaks in some classes of fabrics.

In this class of winding work, the swifts should be equipped with straight fibre, wood, or wire braces, so as to keep the skein

smooth, flat and uniform upon the swifts. The swifts should be kept free from waste and all should be run with the same even tension, so that the bobbins are neither too soft nor too hard. Very soft bobbins cause tangled and loose ends, which lead to considerable waste. Hard-wound bobbins and quills will cause streaky defects in the woven fabric.

The wound bobbins should be handled in the same careful manner as the skeins.

The best results in artificial silk quilling can be obtained by using a special quill, grooved around its entire length, and slightly tapered at the point. The grooved quill grips the silk more firmly than a smooth quill and prevents it from slipping off, thereby saving considerable waste. Wound quills that have been stored for an unreasonable length of time will eventually become too soft for weaving purposes, owing to their drying out.

Work on an artificial-silk warp should, whenever practicable, be commenced and completed the same day. An unfinished warp left wound upon the warp reel for twenty-four hours is thereby subjected to atmospheric changes and may become sagged and slack, making it impossible to secure a perfect and, therefore, satisfactory warp for weaving.

CHAPTER III

WARPING PROCESSES

Various Warping Systems

THERE are many different warping systems in use and opinions differ widely as to which is the best and cheapest in the long run. The warping process has always been an important factor in textile manufacture, which, doubtless, has led to the establishment of so many different warping systems. However, the most rational warping system in regard to quality results is given herewith.

The warps should be built as quickly as possible on horizontal Swiss motion machines, with the use of large bobbin creels, and beamed without picking as soon as the warp is completed. The warp should be placed on a power warp-picking frame, and the picking done at this machine. In this frame there is a special double cross picked, besides those existing in the warp, the warp being put through a special reed for this purpose. This makes possible the elimination of all imperfections and defects in the yarns and other troubles which arise, and so assures absolutely perfect warps, a great advantage when high-speed looms, weaver's wages, and quality demanded, are taken into consideration. The saying in the craft is " a perfectly made warp is more than half woven," and in no process of textile manufacturing is more skill required than in the warping operation.

Warping Machines

There are a number of these warping machines available and they are generally built to suit specific requirements. They can be constructed so as to make any required width or length of warp desired, and the machines are furnished with creels made of wood and iron, or what is known as a pipe creel, all iron, with steel or glass dent reed cased in a wooden frame atop of the creel. The

creel can be made with any number of bobbin pins, as may be required, the usual number being, in practice, from 300 to 1000 pins. Up to recent years, the Swiss machine, with a two-meter reel and a 300-pin creel, operated with a direct-power drive and regulated with step-drive pulleys, had been in widest use, but, with the appearance of the horizontal Swiss motion machine, which has an 8-yard reel, there has been a notable decrease in the use

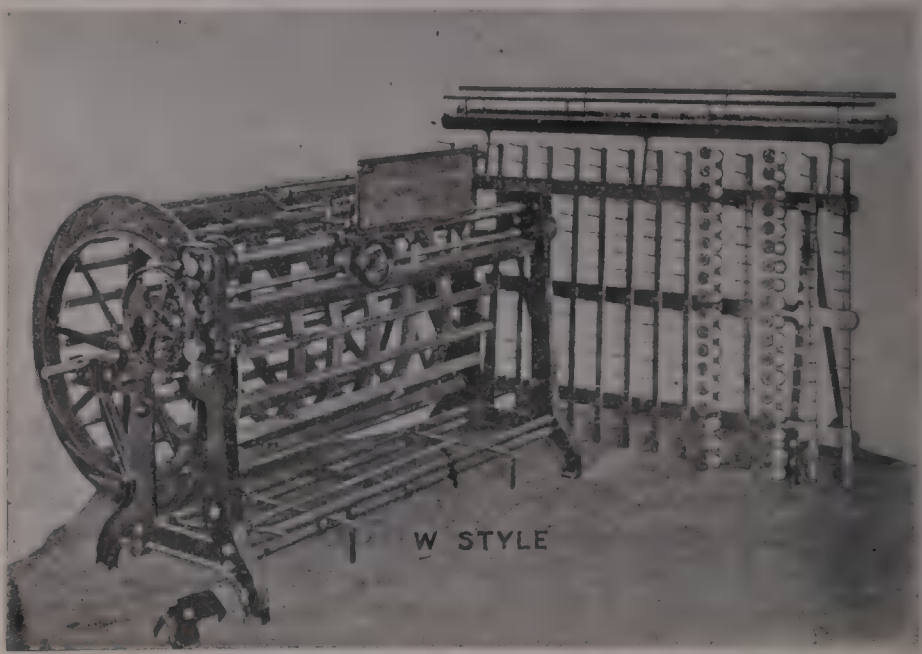


Fig. 6.—Swiss Sectional Warping Frame, and Creel.

of the old Swiss machine, as the horizontal Swiss machine has proved more serviceable and more advantageous in other ways.

Several reasons are given herewith to demonstrate the advantages of the horizontal machine.

1. The operations of warping and beaming are performed on one machine.

2. A larger creel and far greater number of bobbins can be used.

3. Silk and cotton warps of any length and width can readily be built on these machines.

4. The machine is run with friction power, operated with a tread pedal, and can be regulated to run at a steady and smooth speed, or a fast speed, if required.

5. Heavy warps can be made upon these machines.

6. They are easily handled by the operative when it is necessary to pull back and fix broken ends.

7. Then again, the Swiss motion can be disconnected and the machine operated in the same manner as the plain horizontal

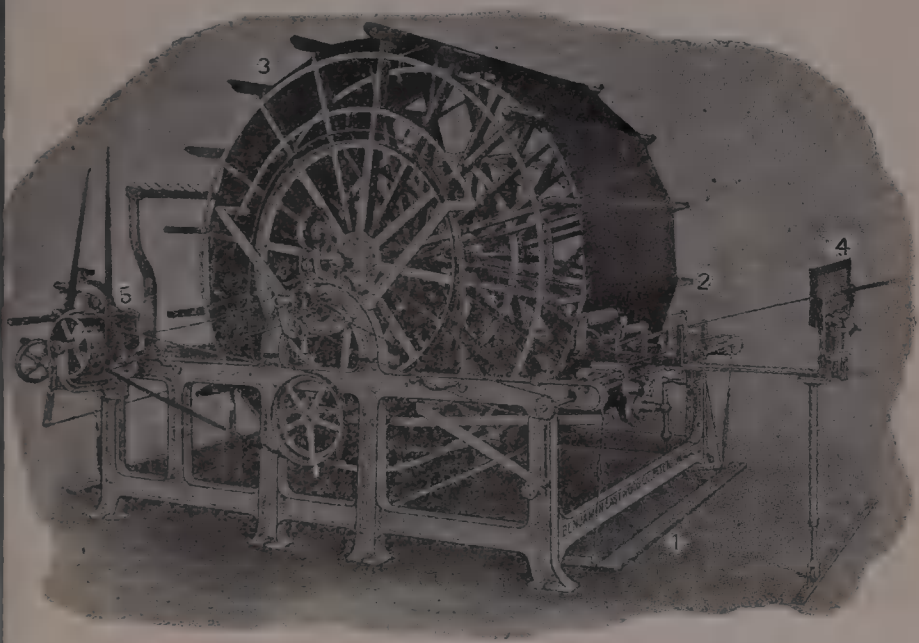


FIG. 7.—Horizontal Warper, with Warp and eight-yard reel. 1. Tread pedal. 2. Carriage, and space reed. 3. Stave. 4. Cross reed. 5. Beaming drive device.

machine, which is a decided advantage when used for making spaced and fancy dispositions and striped warps.

The number of pins required is generally governed by the kind of warp that is to be made. Creels containing 400 to 600 pins are the most commonly used, and the pins should be made $1\frac{1}{4}$ inches longer than the bobbins so that they will be long enough to place an extra bobbin upon each pin. The all-iron pipe creel is stronger, and with its use all bobbins can readily be seen while in motion, a very important point in warping operations.

The reeds used for warping are one single or double cross reed, with as many dents in each reed as there are pins on the creel, and one spacing reed, with as many dents to the inch as are required for the work to be done. There are other cross reeds that can be used, such as a triple or quadruple in the cross.

Male operatives are generally employed to operate the horizontal machines, as it requires more strength to do this work than is usually possessed by the average woman operative, although women do handle these machines successfully with the help of men to lift the beams in and out. The constant treading of the power, and the lifting of the beams and weights, and the high reaching, however, are very tiring. When women operatives are employed for this work, the assistance of a boy is given to lift the beams and weights and do other heavy work which the female operative cannot be expected to accomplish.

The old Swiss warping machine differs from the horizontal Swiss warping machine in the fact that it is more easily operated. Steel crossing bars are placed on brackets between the cross and space reeds to be used for the purpose of forming a cross in each section, and the bars are also required to hold the cross open through the entire length of the section. The reel is much smaller and the warp is wound over the reel, but, when beaming, the warp is wound from under the reel, over a slow traverse or guide roller on the beaming machine, onto the warp beam. The measuring dial, being set for the required length of the warp, stops the reel automatically when the set length is reached. Again, in working, the Swiss machine the operative has no beaming or treading to do as the machine is driven with a friction clutch pulley and is usually started by means of a quick jerk of the shifter. The machine will then keep running at a steady speed until the shifter is used once more to stop it. These sudden stops cause the ends to slacken, a condition which is overcome by the operative turning the reel with the hand.

A smaller creel is used, generally that of the 300-bobbin pin description. Then, again, there is considerably less reaching to be done as the creel and reed frame are lower than is the case on a horizontal machine. A dial is attached to the machine for measuring the length of the warp. This dial must be changed and set

for each different warp length, and so the machine is stopped automatically at the length of the warp. There are elevation irons on the warp reel that are raised or lowered as necessity demands when making a warp. The raising or lowering of these elevation irons is governed by the size of the yarn, the number of ends contained in the warp, and the width of the warp that is to be made. There is no set rule for setting the elevation irons and this matter is usually attended to by the foreman, whose experience has taught him to judge the height at which to set them. When unfamiliar warps are to be made and difficulty arises in determining the heights at which to set the irons, the foreman or person in charge of this work can be guided by the following rule:

How to Adjust the Elevation Irons

After the dial has been set for the required length of the warp, and the elevation irons raised to the supposed correct height, 30 or 40 meters of the first section upon the warp reel should be run, after which operation it will be readily seen whether the correct elevation has been obtained by observing if the width of the section is level. If the section tends to lean towards the right or left it should be pulled back on the arm and the iron raised or lowered until the desired elevation is obtained.

After the correct elevation or height of the irons has been obtained, always taking measurements from their highest points, it is a very good plan to keep a memorandum of same, so that if that particular warp should be ordered made again a reference to this memorandum will prevent loss of time in the setting of the irons. Elevation irons are also known as " grade bars."

Very often a warp is damaged more or less if the elevation irons are not set properly, as it will beam off slack on one side and tight on the other. This defect can usually be overcome by making use of very heavy tension weights and of more beaming paper on the slack side of the warp, but, notwithstanding these precautions, an imperfect warp can usually be expected.

The operation of the Swiss warping machine is very similar to that of the horizontal machine. The differences can easily be grasped by an intelligent operative in two or three days. Although

female operatives are usually made use of in operating the regular Swiss warping machine, their helplessness in the matter of properly completing the warp is often apparent, but, as it is the usual custom to assist one another, male operatives are only required to remove the completed warp, with the reel, to the beaming machine.

Only the employment of the most highly skilled operatives makes perfect warps possible. Good eyesight is imperative, so as to make possible the rapid finding of the many fine ends and threads, the removing of the lumps, knots and other imperfections in the yarns, and also the seeing that all ends are in their respective places in the reeds, so that they will run straight and even and not snarl and tangle. Then, again, there are very difficult dispositions made in fancy and striped warps which require the services of skilled operatives to insure the proper handling of the many details pertaining to them, which, if overlooked, cause considerable trouble in both the beaming and weaving operations.

Beaming machines are separate machines, and are supplied by the builders of the warping machines. They are generally operated by males, as there is more or less heavy lifting to be done, although, in some cases, beaming can be accomplished by female operatives after the warp, wound upon the reel, has been lifted onto the beaming machine.

Banking, Tying Up and Reeding a Plain or One-Colored Warp

When instructions to make a warp have been received by the operative from the foreman, he should examine the warp order ticket to ascertain the lot number, material, and color of which the warp is to be made. The amount of material necessary to make the warp, and the number of bobbins to accomplish the work, should be carefully calculated, whether or not there are enough called for to fill the creel, for the plan and scope of the warp is the first thing to be considered.

Before the bobbins are banked up, the creel and bobbin pins should be absolutely clean and no waste of any kind should be allowed to remain on the bobbin pins or in the reed of the creel. When everything is ready to begin work, all bobbins are placed on

the bobbin pins of the creel. If the warp is to be made of one color and material, the bobbins are placed on the left-hand side, the first row facing the creel, and so worked down and up, on the rows of bobbin pins, to the right of the creel. If there are ends in the reed left from the previous warp, the new ends should be tied or twisted thereto. In twisting or tying ends, it should be borne in mind to have the old ends so fastened that they will remain with a firm tension on the ends in the reeds. If there are no old ends in the reed, the new ends are passed in the reed of the creel one by one, care being taken not to miss a dent or put two ends in a dent, as this will interfere with reeding the cross reed. Care should be taken to see that every end is in its proper place through the creel reed. Each row of ends is then twisted together and laid on a bobbin pin. After the creel is banked and reeded, the number of bobbins on the creel should be counted, and each one placed in its respective position so as to make sure that the required number of bobbins are in the creel. The first and last end on the creel should be placed on the outside of the first and last dent of the reed, which will leave an empty dent on each side of the creel. This will give the operative a better view of the outside ends, and it can be more readily seen when the ends break out while the machine is in operation.

A background of either paper or cloth, black or white, whichever is best suited for the warp, arranged so that the ends can be distinctly seen when breaking, or dropping out of the reed, while the machine is in motion, is very necessary. All creels should have the number of bobbins marked on the reed frame of the creel over the top of each row of pins, starting with the first row facing the creel on the left and adding each individual row of pins to the next on the right and so on, until the last row of pins will have the total number of bobbin pins on the creel. This will save time and trouble in counting the bobbins while banking or tying up.

Reeding the Cross Reed

The cross reed is composed of a certain number of dents and contains an even number in the reed. A single cross reed has one dent open and the next partly closed, each open dent being followed by a partly closed one the whole length of the reed, which

forms the shed of the ends in the reed so as to make a cross. This also applies to double, triple and quadruple cross reeds, although a single reed can be used for either one, but it will be a different operation. Reeding double, triple or quadruple ends in a single dent in this way, it will be very difficult to see any that are misplaced, broken or run out.

Before reeding, a strip of stiff paper, either black or white, about the length of the cross reed and about $2\frac{1}{2}$ inches wide, with rounded corners, should be placed upon it. This will partly cover the dents of the reed and will serve as a background, so that the ends may be seen more distinctly, and to also hold them in place when being reeded.

The bottom of the cross reed, during the reeding operation, should be held close up to the back of the glass reed on the creel top, and should slant backwards and upwards at a convenient angle. The lower edge should rest on the frame of the creel reed and the upper edge be held in its slanting position by a light wire hook which also hooks over the top of the glass reed, and it can thus be easily slid along as the reeding proceeds. The reed should be placed on the right-hand corner facing the back of the creel. If the creel is too high for the operative to reach the reed, a platform to stand upon should be furnished for this purpose. The ends of the first row should be drawn over the reed with the left hand, the right hand holding a warper's reed hook, which should be passed through each dent so as to draw each end through from the bottom side of the reed and through its respective dent. After the ends of each row are drawn through, they should be knotted to prevent them from slipping out of the reed. This operation should be done by sliding the reed to the left from one row to the other until all ends on the creel are reeded. After all ends are reeded, the cross reed is carefully removed from the creel and placed in the reed frame on the carriage of the warping machine, and the knotted ends are then drawn out far enough to hang over the top of the cross reed and so are ready for space reeding.

The space reed is somewhat different from the creel and cross reeds, as it is more compact, has finer dents and is used to determine the width of the section. The ends in each dent are governed by the width of the warp.

The number of dents in a spacing reed varies. It is especially pointed out that, when warping, the same counts or dents of reeds used for weaving are not necessarily employed. It largely depends upon the yarns, and the fabric that is being made. Generally speaking, a 30-dent reed can readily be used for most warps.

To find the number of ends that each dent should contain, the following rule will be found to work out satisfactorily: The total number of ends in the warp should be divided by the width of the warp. This result will give the number of ends to the inch in the warp. This quotient is then divided by the number of dents in the reed, which result will give the number of ends to be reeded in each dent. For example, a warp containing 4640 ends —width 29 inches, 30-dent reed used.

4640 ÷ 29 inches = 160 ends per inch
160 ÷ 30 inches = 5 ends and 10 over.

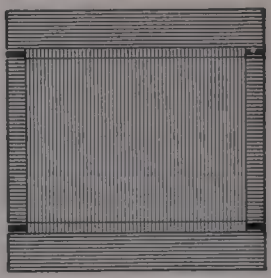
In this case it will be seen that the warp will be reeded first two dents, 5 ends each, then every third dent 6 ends, and repeating in this manner until all the ends are reeded.

To Reed the Space Reed

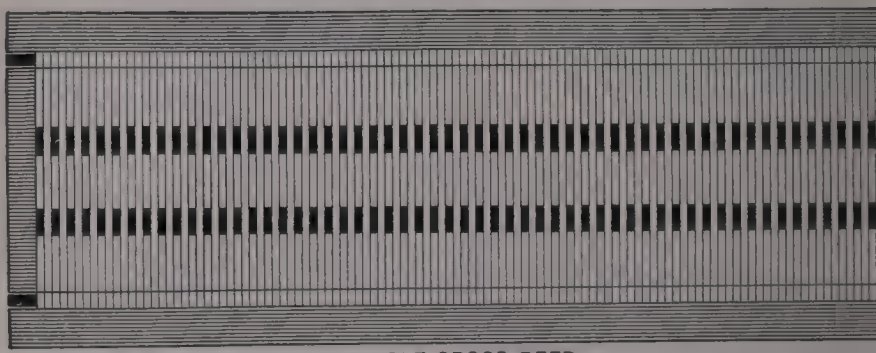
A strip of stiff paper, either light or dark, of about 2 inches in width and the full length of the space reed, with rounded corners, is used. This strip of paper, which is used for a background, is placed upon the top of the space reed, which is held in the left hand at right angles, and at the bottom of the cross reed. A number of ends are taken in the same hand and the number for ends to be placed in each dent are counted by means of a reed hook which is held in the right hand, and by which the ends are pulled through the dents. Great care should be taken to place each end in its proper dent. After the spacing reed is reeded it is returned to its place on the carriage with all the ends tied in one knot.

How to Ascertain the Starting Mark of the First Section

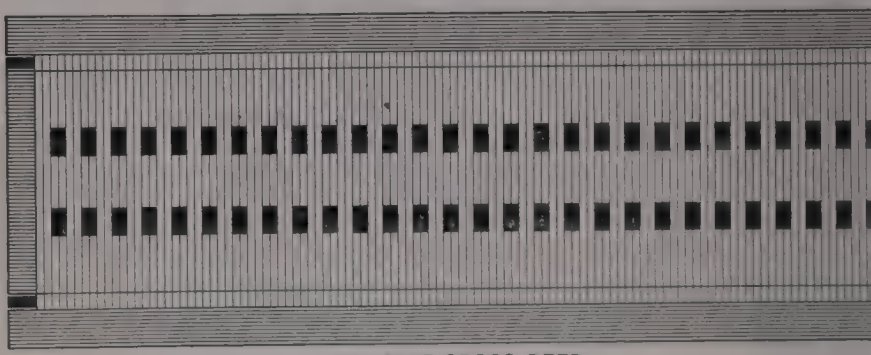
To ascertain the starting mark of the first section, so as to reel the warp on the center of the reel, where there is more than one



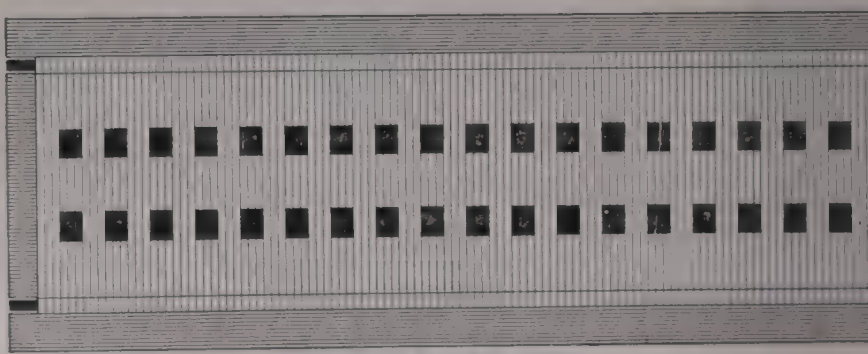
SECTION SPACE REED



SINGLE CROSS REED



DOUBLE CROSS REED



TRIPLE CROSS REED

Fig. 8.

size of beam used, it will be necessary, first of all, to know the size and length of the beam that the warp is to be beamed over, so as to beam the warp on the center of the beam. The beam is placed in the proper device on the warping machine and the exact center of the beam is marked. The reel of the warping machine is then turned so that the slat containing the row of pins faces the beam. The mark on the center of the beam—being the center of the imaginary warp—should be transferred to the slat containing the row of pins. The reel is then turned back to its original position and the mark which corresponds with the center of the beam serves as the guide to place the warp on the reel. It should be understood that whatever width the warp is to be made, one-half of the warp will be on each side of this center mark. For example, take a 24-inch warp. Measure $12\frac{1}{2}$ inches from the center mark of the warp, allowing $\frac{1}{2}$ inch more for contraction in the width of the warp, and from this point start the first section.

In making warps, it is sometimes best to make them a trifle wider than the order calls for but never in any case should they be narrower.

Preparing the First Section to Wind on the Reel

This particular section should be passed under the first guide roller and over the upper second guide roller, and the knotted ends hooked on the pin of the slat nearest to the starting mark. This will hold the section in place while the cross is being made in the section. To make the cross, the section is raised with the left hand so that one-half of the number of ends forms the upper shed at the cross reed; the cross rod is then passed through the shed, so securing this half of the cross with one of the cross sticks that are on the carriage between the section rollers and reed. The reel is then slightly moved so as to tighten the slackened ends of the section, and the section pressed down with the left hand so as to form the lower shed. The other cross rod is now passed through the shed as before so as to secure it with the other cross stick. The ends should be examined closely to ascertain if they are properly crossed. If this be the case, the ends will be one over and one under, on either one of the cross sticks, throughout the warp.

Two lease cords, long enough to reach over the width of the reel, are then tied on the right side facing the reel, say about half a yard above the slat with the pins and passed through the cross of the section under the first or smaller guide roller, the reel being sufficiently moved so as to permit the tying of the other end of the lease cord, which should be passed through the cross of the section, and so on to the left side facing the reel.

To Set the Measuring Dial

After this is done, the movement of the measuring dial should be tried. To accomplish this, the dial is turned so as to ascertain in which direction the dial moves and so mark the correct place on the teeth. The dial is then loosened and slid out, which enables it to be turned either back or forth as required.

A chalk mark should be made on the dial between two of the teeth, which answers the purpose of a starting mark for measuring the length of the warp. Usually, the circumference of the reel measures 8 yards. The distance from one slat of the reel to another will measure half a yard. By turning the reel completely around, the teeth of the dial will be so moved as to pass the starting mark, consequently every tooth of the measuring dial will indicate 8 yards upon the warp reel.

To set the dial for a certain number of yards, the number of yards should be divided by eight and the result will designate the number of teeth to be counted from the starting mark of the dial. For instance, a warp is to be made 120 yards long. Dividing 120 yards by 8 gives as a result 15. Therefore, fifteen teeth from the chalked starting point will be the starting mark for this particular warp.

If the warp is to be made less than 8 yards, the number of yards should equal twice the number of slats, each slat signifying one-half yard; the required length is thus obtained and the same process will work out for cuts and cut-off marks.

The dial should be so set as to cause the bell to ring when the last 8 yards of the section are about to be finished. This method should be tried out a few times so as to make sure that it works correctly. By setting the dial in this manner, the operative

will be warned to watch for the cut-off marks. The dial should be examined very carefully before starting the section, and also before cutting the finished section, so as to make sure that it is set right and has stopped at the correct mark.

Power-driving Devices

The driving connections are arranged so as to run the beaming direct from the main shaft; but the reel is driven by means of the two grooved pulleys and one friction pulley on the right side of the reel, and is controlled by means of the treadle to start and stop the reel.

Winding the First Section on the Reel

Before starting to wind the section upon the reel, the operative should note that the measuring dial is set correctly and that all ends are in their proper places in all the reeds, as well as in all the crosses. The treadle should be used to start the reel, which must run very slowly at first. Close watch should be kept on the ends at the creel and cross, so that if a break occurs, or an end drops out, these things will be immediately noted. A good way to detect breakage is to place the left hand lightly, and in a flat position, over the section, as in this way the hand will feel the slack and tight ends, and thus the ends that break out will be easily detected. Broken ends, as well as those which have dropped out, can also be readily detected by the empty dents at the cross reed.

When such droppage occurs, the ends should be passed through the proper dents and then fastened to the ends on the carriage wire made for that purpose. The missing ends should be traced through the space reed and the section separated with the small wooden pins that are placed on the carriage for this use. The next step is to wind the section on the hand and at the same time it should be pulled back. This operation should be repeated until the missing ends are found. The broken ends should then be tied together and slowly run back with the section. Great care should be taken in this operation as well as in the notation of the cut marks.

If at any time the section should be run past the marks, it will be necessary to carefully pull it back through the space reed. The

section should be wound upon the arm, or a large bobbin, until the marking place appears. The cut marks should then be put in their proper places and the section run back upon the reel. In case the section should happen to run past the cut-off mark it will be quite necessary to make two sets of crosses and to have the section pulled through the cross bars and reed. When the section is so run back, and reaches the required cut-off place, the lease cord should be passed in the crosses, the section cut, and a knot tied in both ends. The ends should be secured by looping the knotted ends through the finished section. After the dial is set, the end of the section remaining on the arm should be hooked on the pin; the lease cord should then be put through the crosses and the section may be run off the arm and onto the reel. Accurate manipulation in this operation is assured if the operative has proper assistance.

The first and second sections should be run very slowly, for the very good reason that the operative has to contend with many important and distinct operations. The skilled operative will pick the large lumps, knotted waste, soft and split ends, " caterpillars," " sleepers," double ends, and other imperfections from the warp. It is usually the case that when bobbins are full they do not run very smoothly at the start. Then there are times when the warp requires more than one cross at each end, although usually one cross is sufficient, which necessitates the watching of the dial very closely so that the reel may be stopped when extra cross and cut marks are to be made. When the section is completed to the last yard, a lease cord and a cross should be secured in the same manner as the first cross. The reel should then be moved to the cut-off marks and the section cut off. A knot should be tied in both ends of the section leaving knotted ends about 2 inches in length. The section may now be fastened by pushing half of the knotted ends through it, for, by this operation, the other half of the ends will remain on the outside of the section.

The Second Section of the Warp

When the first section is finished, the width should be measured before the second section is commenced. Having found the width

of the section, the compass or ruler should be used to space the width of the warp according to the number of sections required. If this calculation proves correct the operative may continue making the warp, but, if it is incorrect, it will be necessary to change again the reeding of the section in the space reed, so that the correct width of the warp may be arrived at.

The mark of the next section, which should be the width of the section on the sliding board, is next placed beside the carriage, which, in turn, is moved to the new mark. A compass has proved to have been, by long years of experience, a very handy adjunct for this space work. The cross being made and the dial set, work may proceed on the section. When this section is finished, if, by chance, the sections are too close together, they should be separated by running a pointed bone pick between them. If the work so far accomplished is satisfactory in every detail, work on the balance of the warp may be proceeded with until it is completed and on the reel.

Some unskilled operatives have the bad habit of leaving a small space between each section when engaged in the setting operation. To cover the space, this class of operatives adopts the questionable practice of pushing and sliding together the ends as they are wound and finished on the reel. It cannot be urged too strongly that this is the wrong method to pursue, for all kinds of warps. It injures the silk, causes the ends to roll and twist, and thus disturbs the whole section. Again, when beaming the warp, the sections are often not sufficiently closed. To cover this bad workmanship, the operative, in his efforts to bring these sections together, usually adopts the very bad system of hammering and pounding the warp with the fists. Such methods should never be used by the efficient operative. It is far better to have the sections a trifle too close, and separate them by running the picking bone between the sections, which should be placed as near as possible to their correct mark. When heavy and long warps are being constructed with the use of coarse size yarns, such spaces, as referred to above, often occur, but almost invariably these defects can be charged to inferior workmanship.

In case there is any danger of the warp becoming too wide by cutting down into many sections (due to working with a scant lot

of material and with a small number of bobbins), it would be well to plan it out before reeding, and to have the space reed stitched narrower than would be done for a full creel and a greater number of bobbins. If this course is carefully pursued, it will not be necessary to push, slide, nor pound the sections together, providing good judgment is used regarding the proper tension weights and the amount of beaming paper that is required when beaming the warp. To overcome these difficulties, I would strongly advise the use of the Swiss motion machine.

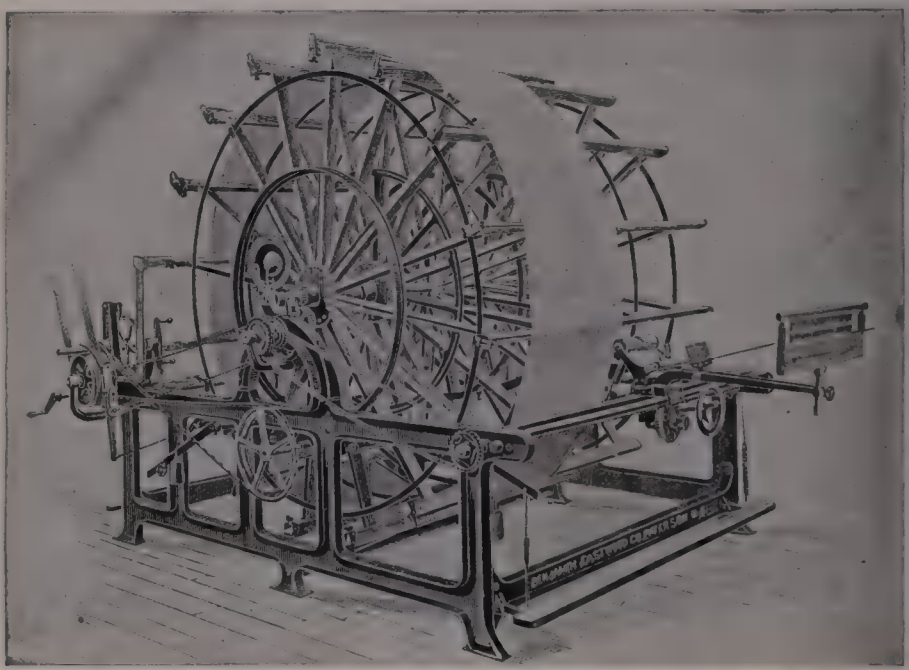


FIG. 9.—Horizontal Warper with Swiss Attachment and Elevation Irons.

Beaming Warps

When the warp is completed, the lease cords should be cut from the reel and a knot tied on each end of them. The reel should then be turned until the knots of the sections face the beaming attachments. The beam should be lifted into its place and the reel steadied by the emplacement of one tension strap. Next, the beam apron and rod, which are attached to the beam, should be

held firmly by the operative and the work commenced of tying the section to the apron so that all will be in readiness to wind the warp upon the beam. The warp may be tightened on the beam by slightly turning the pulley with the hand. When the warp is ready to be beamed, a sheet of beaming paper should invariably be placed on the beam under the warp.

It often so happens that, during the operation of tying the sections on the apron of the beam, they have a tendency to open and spread apart. To remedy this defect the first necesssry operation is to move the sections back to their original position; this being accomplished, a sheet of beaming paper that has been tightly rolled should be held high on the open sections by the operative. The beaming operation is then continued with the roll of paper resting on the warp so that it is carried down to the beam, the roll of paper being then drawn up to the place from whence the operation was started. This operation should be repeated until the sections are closed and in their original positions.

For the emplacement of piecing bobbins, which are used for tying the lost and broken ends in beaming operations, a rod or pin rail should be placed across the warp and beam.

The beaming of the warp should then be continued very slowly, one or two turns around the beam and paper being sufficient, the treadle being used to start the operation. The second tension strap, with weights enough to tightly beam the warp, is then put on.

Attention is called at this point to the fact that the successful carrying out of this operation depends upon the nature of the warp, and as warps are constructed of many different sizes of yarns, and contain a varying number of ends, good judgment is needed.

Another point is that, when the operative is beaming a warp, if there is any slackness, it should be immediately remedied, as in such a case the warp will sag and beam loose on the edges. On the other hand if the warp beams too tight a number of ends will surely break from it. These defects may be obviated in either case by the addition of weights or the removal of same from the tension straps.

The careful operative invariably attaches to the machine a sheet of cloth or paper, which may be either white or black, be-

tween the warp and beam, which gives an excellent background when she is engaged in picking and cleaning the warp threads. When the warp is nearing completion, great care should be taken to note the short ends. If such be prevalent they should be broken about a half yard or so from the cross and tied to the piecing bobbins, after which the beaming operation may be successfully continued. Short ends should be found and pieced out. If long ends and " ringers " are encountered they should be broken and tied in their respective places at the cross. After all the short and long ends are tied, the reel should be turned slowly and carefully to the end of the warp. The sections should be taken from the pins, grouped together and tied with a slip knot, and wound on the beam. The warping beam should be carefully wrapped in paper and fastened at each end and in the center. The required piecing bobbins should be attached to the outside of the wrapped beam so that, when delivered to the loom, the warp will be complete in every detail.

To Make Disposition Warps, Fancy Stripes, and Ombrés, on the Horizontal Machine Without Using Swiss Motion

In the first place, a beginner should not undertake the construction of any description of disposition warp, as a wide and varied experience is absolutely necessary for this class of work, therefore, a careful study of the following remarks on this branch of warping is recommended to the beginner. Skilled operatives thoroughly understand that, when a disposition warp is in the loom, the disposition and pattern is read from left to right, facing the lay and reed of the loom. But, when banking and tying up for a warp on the creel, the disposition is read backwards, facing the front of the creel.

In this operation, the first bobbin and end is placed on the lower right-hand bobbin pin, which, in turn, will be the last end of the warp when it is completed for the loom. The operative should continue to bank up toward the left side of the creel, reading and making the warp backwards. After the creel is banked, and the ends reeded and properly crossed, the first section should be placed on the right side of the reel, facing it. If the pattern requires as

many ends as can be banked on the creel, or if the sections can be completed without reversing, or if it is possible to reverse the reed so that it is bottom side up for every other section, and if again the warp can be run in this manner, the sections can be placed next to each other, which operation can be continued indefinitely.

It will be readily seen that this construction is similar to that applied in making a plain warp, but if the warp to be constructed demands a number of spaces, the first part of the pattern should be banked, tied and wound on the reel, after which the width of that particular part of the section should be measured and spaced on the reel as many times as it will repeat in the pattern of the warp. After the first section is completed on the reel, the long lease cord should not be used for the cross in the following section, a separate cord being used for each separate cross.

After the first part of the space warped is on the reel and complete, the next parts of the pattern should be banked and tied, and then placed in the spaces planned for them. After the warp is built on the reel and beamed off to the cross, a long lease cord should be passed through all the sections before the small separate cross cords are cut out. This method is also applied to the first cross in the warp, if so required.

Proper Number of Bobbins to Wind for a Warp

In preparing a warp, an important point to be kept in mind is the winding of the yarn on just the proper number of bobbins that will best suit the requirements of work, which knowledge enables the operative to finish the warp in the shortest possible time. The ability to do this handily forms part of the equipment of the skilled operative and is only acquired by a long and varied experience in the warping branch. The busy mill owner must necessarily depend on the judgment of such operative and generally does so.

To make this entirely plain, we will take an example. For instance, should the bank or creel contain 600 bobbin pins, it is, of course, the best and quickest way for the operative to have what is termed " a full bank," and so keep repeating right along with the use of these 600 bobbins and ends until the desired num-

ber has been obtained for the warp. This method answers admirably in cases where there is an unlimited supply of yarn with which to work, and as is usually the case in mills where one color warps, for large orders, are principally used. But when the operative is called upon to use a variety of colors, in constructing a warp for fancy fabrics, it is absolutely necessary to arrange to have a single skein divided among a number of bobbins, so that the operative's bank or creel may be kept as full as possible, and at the same time be of sufficient length to run out the warps. No hard and fast rule can be laid down for the best course to pursue in the operation just touched on, as each mill requires different methods and so the matter once more becomes a question of experience and judgment.

The warper foreman should see to it, very carefully, that the proper number of bobbins is wound for the work in hand, for carelessness in this respect may cause the loss of many hours of time. Towards the end of the work on a warp, when the bobbins are running out, it becomes necessary to reduce, or cut down, the number of bobbins, as, otherwise, ends will be running out everywhere, and great trouble and loss of time will result. The yarn from these almost empty bobbins will often have to be backwound, or concentrated, on a smaller number, so as to give sufficient length to finish the warp. In doing this, it should be seen that the proper number of bobbins is kept out for piecing, and for tying any other threads that may run out before the section is completed. Threads that are carelessly allowed to run out, and which are found missing when beaming the warp, have then to be replaced, with not only the attendant trouble and loss of time, but, also, these threads will have a different tension, and so may make streakiness in the warp.

Making Warps on the Horizontal, or All-Swiss Motion Machines

It should be kept in mind that all warps are made and started by banking and tying upon the left-hand top-corner pin facing the creel, and working towards the right of the creel, reading the order or disposition from the beginning as it develops. When the creel is banked and the section ends placed in the reed, the elevation

irons should be set and regulated to the height required for the warp. After the irons are elevated, the dial set for the length of the warp, and everything in readiness to start, the first section should be placed on the left side of the reel, facing it, and at the lowest point of the elevation irons.

It should be understood that very light (weight) and short warps do not require the use of the elevation irons, but it is entirely different when making heavy (weight) and long warps, as these cannot be made perfectly without the proper regulating and setting of the elevation irons.

Every revolution of the reel will then cause the worm screw to move the carriage, so as to wind and traverse the section to the left on the elevation irons when the machine is in motion. The longer the sections the more they will spread on the elevation irons, and, in due course, the sections following will traverse and spread each over the other. This treatment will give the warp the appearance of being built higher on one side than on the other; but when the warp is completed on the reel it will be level across the width, and will taper at the finished side. The beaming device should be so arranged as to correctly traverse the warp back to the center of the beam.

The Advantage of the Horizontal Plain Direct Warping Machine Over the Horizontal Swiss Motion Machine

The advantages obtained with the use of the horizontal direct-warping machine depend largely upon the circumstances under which the warp is to be constructed. To become a skilled operative in this branch of warping, long experience and good judgment are essential. It is not to be expected that all kinds of warps can be perfectly made on the horizontal plain machine. A warp calling for a yarn of fine size or count, with not too great a number of ends to the inch, and a limited length of yardage (in fact, all light warps), can be made, perhaps, more perfectly and certainly more easily on the horizontal machine than on that with the Swiss-motion attachment. The same rule applies also to warps constructed with the use of coarse yarns. Disposition warps are read and banked on the creel in direct reverse to methods used with the

Swiss motion machine. This often proves advantageous, as the sections can be spaced off and placed on the creel as desired by the operative, which means a saving of considerable time in tying up the ends.

Much unnecessary time is consumed in tying up ends for repeated sections on a machine with the Swiss motion. The operative should face the reel as the warp is wound on the reel and when the cross is made, the lease cords should be drawn towards the operative. The clock dial is on the left-hand side of the operative in plain sight and so gives no excuse for time wastage or mistakes.

It is certainly unreasonable to expect the operatives to undertake the construction of extraordinarily long and heavy warps and expect them to turn out perfect work, as only a limited length of warp and weight can be perfectly made without section marks, and skilled operatives must use good sound judgment to avoid such defects. It can be readily seen that the longer a heavy warp is made, the higher it will pile up, thereby making the section curved instead of lying flat. Naturally, the ends of the side of the section are much shorter and, therefore, are bound to beam off tight, thus stretching them out of their natural size, and, as the ends in the center are more or less slack, section marks in the woven fabrics are often the result of this defective work.

Miscalculations are easily made in constructing a warp of this description, especially when the limit of the length, weight, and width of the warp, and the size of the material, are overlooked. Fabrics woven from warps of this description are subject to section marks, tight and loose ends, and other defects. One convincing proof is the comparison of a 2- or 3-yard reel with an 8- or 10-yard reel and the construction of the same kind of warp upon both. Another is to unwind a few yards of a heavy warp that has been made on a plain and straight-motion warp machine with light-tension weight. It will then be readily seen that on one side of the warp, or between each one of its sections, there will be a tendency to slide or slacken, a condition which should not exist in a perfectly made warp.

Some of the Advantages Gained on the Horizontal with the Swiss Motion Attachment

Perfect warps can be made with the use of Swiss motion machines regardless of any size or length, although it must be said that considerable skill and judgment is necessary to achieve such results. All disposition and plain patterns are read and banked

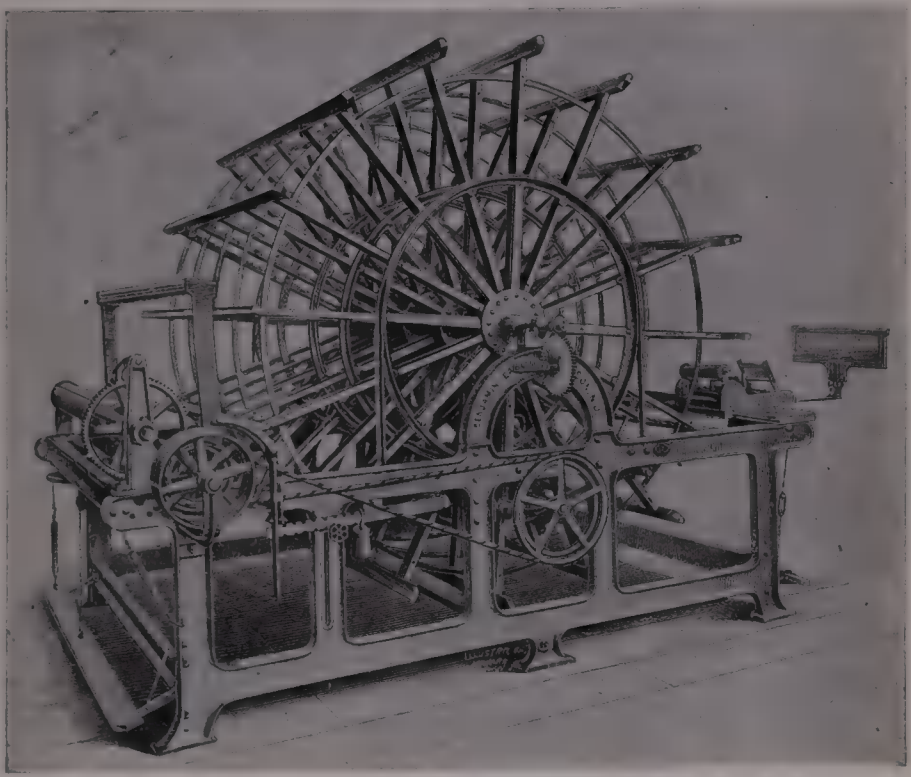


FIG. 10.—Empty Horizontal Warper (without Swiss Attachment).

from the beginning. The ends are banked on the creel from the left top pin working towards the right of the creel, which is just the reverse of the workings of the plain horizontal machine, for fancy patterns.

The sections, when placed upon the reel, move from left to right, and this traverse movement on the Swiss machine will overcome all lapped sections and prevent section marks, defects

largely due to inaccurate spacing and by omitting the proper treatment required for this class of warping when accomplished on the plain horizontal machine. It is not necessary to go into details and describe a variety of limited warps that can be constructed on the plain horizontal machine, as this knowledge is best attained by experience and is largely governed by the kind of fabrics to be woven from the warp.

Valuable Points in Warping Operations

The foreman of a warping room should never give verbal orders to the operatives under him for the construction of a warp, as such a course very often leads to misunderstandings which, in turn, bring about troublesome and costly mistakes. The intricate and necessary details met with in warping operations fairly demand that all orders to the operatives should be plainly written. When the operative is given the warp order ticket and does not seemingly understand the details called for in the making of the warp, he should immediately ask the foreman to make these points perfectly clear, otherwise he assumes the responsibility, and must account for mistakes which may occur in his work.

Generally speaking, and whenever possible, the operatives should obtain all orders for warps in writing, to avoid useless arguments and disputes, and should furthermore insist upon being furnished with a lot ticket with each lot of yarns given for the work, which, in turn, should be checked up to see that it corresponds with the lot number of the warp ticket and in other essential details.

In warping operations, when changing from silk to cotton or vice versa, the operative should never twist or tie the new ends to those remaining on the creel, they should be cut out and reeded anew. Otherwise, trouble is bound to result, as the ends and knots will twist and tangle and break out when drawn through the creel reed.

The operative should never attempt to work with slack ends, as it is impossible to accomplish the right sort of work without having a strong tension on the ends.

Before starting to build the warp on the reel, the operative

should be sure that all bobbins that are designed to go into the warp are in their proper places on the creel, and in the reeds and cross.

In constructing disposition warps, it is not only customary, but advisable, to have another operative assist in counting the ends of each color and checking off, so as to ascertain that each end is correctly placed.

In making some classes of warps, it is a dangerous practice to tie up full bobbins on one side of the creel and place partly empty bobbins, or what are commonly known as "skinners" on the other side; such work is apt to cause streaky warps. It is best in all cases to mix the bobbins evenly over the creel and on both sides. Then, again if the bobbins are wound by different operatives, with the result that some are wound hard and others soft, streaky warps will again ensue, especially so if the bobbins are not properly mixed on the creel.

Disposition Warps

When making plain or disposition warps, the operative should always use an even number of ends, providing the pattern permits of this procedure. If an odd number of ends are used the cross must be taken the reverse each time; that is to say, the first section up and down, and the next section down and up, otherwise there will be one end in the wrong place at the cross and so repeated in every section of the warp. These are commonly called "flats."

Unfinished Sections

A section should never be left unfinished by the operative over night, if possible, or for any unnecessary length of time during the day, as there is always danger of the ends slackening and the vibration of the mill cutting out ends at the reeds both of which happenings invariably cause considerable trouble and often damage to the warp.

Lost Ends in the Warp

To overcome and prevent the mishap of ends unaccountably lost in the warp, occurrences often caused by a single end not running properly with the rest of the ends (commonly called

" sleepers "), or should the first and last ends of the section break or run out and not be noted by the operative in time, the method of rubbing the palm of the hand carefully and frequently over the section, when it is in motion, tends to dislodge such loose ends and, at the same time, gives the operative a better opportunity of watching the first and last ends, to prevent the occurrence of flats and lost ends.

The Matter of Available Yarns

When there is but sufficient yarn on hand to make a single warp, entirely different methods are pursued for making warps than would be the case if there were sufficient yarns to make several warps. The handling largely depends upon the yarns, yarn sizes, number of ends contained in the warp, and the length of the warp to be made, all of this knowledge being necessary to ascertain the number of bobbins needed, and the quantity of yarn needed for winding operations, which knowledge of requirements will greatly minimize the reducing of the ends.

When it becomes necessary to reduce the number of bobbins, care should be taken by the operative to maintain an even number of ends and still have enough to tie in place of those which run out in the next section. If by chance the bobbins should run out, leaving none to tie in their place, the yarn on several of the fullest bobbins should be transferred to others in order to obtain enough bobbins to finish the section. This operation may be repeated until the warp is completed.

The Creel

There are many different styles and makes of warp creels. This is evidently due to the number of kinds of fabrics manufactured and a proper selection is, therefore, a very important consideration in the matter of warping. The most objectionable feature about most creels is their clumsy construction. The wooden rails running crosswise on some hide several rows of bobbins, and the failure to see these many times causes the ends to run out without being noticed. Yarn is wasted and smashes occur, in addition to which, time is lost. The writer has had

considerable experience with this trouble, and earnestly advises all mill men in similar positions to adopt his policy of using the so-called pipe creel. This is constructed of an all-iron straight frame of the required size, from 300 to 600 pins, standing upright on rollers and portable. All bobbin pins are $1\frac{1}{4}$ inch longer than the bobbin, and every pin is furnished with resistant porcelain buttons. With this style of creel every bobbin can be seen plainly. This is a very important factor in high-speed warping, as ends or bobbins may run off when in motion. It is also an advantage to have the number of bobbin pins stamped in plain figures on the creel reed frame at the top of each row, and carried out to the full number of pins on the entire creel. This is an advantage, too, in saving time and lessening the liability of mistakes in counting bobbins, as the number of bobbins and ends required will always be in plain sight.

The floor space a creel occupies is usually too small. In some cases it does not make much difference, but, as a rule, it is poor policy to crowd the creels too close. Neither should it be too far from the cross reed. Either fault will cause defects. If the creel stands too close, the friction caused by the rubbing of the ends on the outside reed bars of the creel, and on the reed blades of the reed at the same time, will be too great; on the other hand, if the creel is too far away, the distance will be too great for the operative to see the ends plainly, and time will be lost in going back and forth to repair the ends and replace the bobbins.

The distance of a creel should be from $4\frac{1}{2}$ to 6 feet from the cross reed. Naturally the space varies according to the size of the creel. The more bobbin pins there are on a creel, the wider and higher it will be; the wider a creel is and the narrower the section of a warp is to be made, the more friction there will be on the outside ends when they are in motion. This is a trifling defect that cannot be entirely overcome, owing to the shape of the section. The fact that this is so wide at the creel and so narrow at the cross and space reeds, causes the outside ends to rub against the creel reed bars, and cross and space reed blades, more than the ends running from the center of the creel. But it must be borne in mind that for this reason the creel should be moved and kept in the center of each section at all times. If the creel stands con-

siderably more on one side than the other, there will be more friction on one side, and section marks, and streaky defects in some fabrics of delicate plain warp effect, can, therefore, be traced to too much rubbing of the warp ends on one side of the creel. In such cases, if the warp did not receive the proper treatment, or if the tension weights were not right, nor the beaming paper properly applied, and if slack and tight ends appear from the creel, the use of proper tension weights and plenty of beaming paper will offset these defects so that they will not be discovered. The

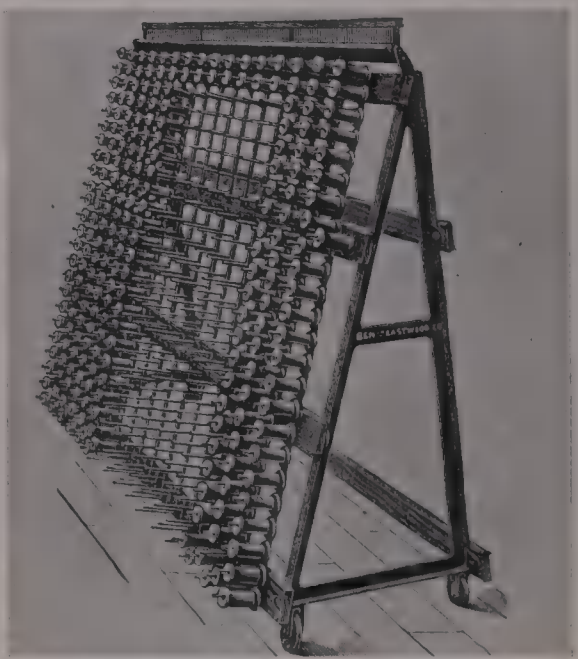


FIG. 11.—Four-hundred-pin Bobbin Creel.

same is true of such a small technical point as a bobbin running almost empty on one side of the creel while a full one is running on the other side. These bobbins will pull and run off with a different tension, but this is only a trifling defect that cannot be overcome. It will disappear with good tight beaming.

For some classes of warping it is not necessary to be too exact in the matter of room and space. The creel can be stationed in one place and not moved, provided there is sufficient space to work around it conveniently.

The Difference Between a Creel Containing a Full Set of Full Bobbins, and One Containing Partly Full Bobbins

When operations are commenced by the operative on the construction of a warp with a creel banked with a full set of full bobbins, very often the bobbins will run with an entirely different tension than is the case when the bobbins are only partly filled. In some cases the difference is so great that it causes the warp to beam off slack and tighten on one side. To overcome this defect in beaming operations the warp should be treated with special care by the operative. Extra weights, beaming paper, as well as special strips of paper, must be used to build up the slackness so as to keep the warp running even on the beam so that when finished it will meet weaving requirements.

Warps which are not completed in one day and for some reason left unfinished for a day or so or, perhaps longer, are usually found slack on one side when operations are resumed. This condition often exists in warps that are made with the Swiss-motion attachment. Very often the elevation irons are not set correctly and so bring on this defect. Rebeaming the warp once or twice has a tendency to improve and remedy these conditions.

The Brake Strap

Brake straps are not furnished with the machines, but the operative should always be furnished with this device, as it is impossible to properly construct warps without their use. They are used to steady and control the reel and prevent it from turning too freely when the section is pulled back. The accepted method of attaching a brake is as follows:

A thin narrow strap or rope, long enough to reach from the front to the back of the frame of the warping machine, is placed underneath the reel. One end is attached to the frame at the point nearest the beaming device and the other end is passed down and underneath the reel, in a position about 2 inches from the ends of the slats of the reel, to the front part of the frame underneath the carriage table. A screw eye is fastened underneath the carriage table through which the strap or rope is passed and a

weight, sufficiently heavy for the purpose, is fastened to the end of the strap or rope so that the required tension may be obtained to hold the reel in place.

The Guard String

This is a device provided by attaching a strong white cord on each side of the reed frame and stretching it to the creel frame on each side. A small weight is placed on the end of each cord and the cords should be long enough to hang over the creel so that they can slide up and down freely, when it is necessary to move the creel.

Bobbins that Spin Off the Pins

Should the bobbins show a tendency to spin off the bobbin pins of the creel, when warping operations are being conducted at fast speed, the pins should be oiled, waste that has been oiled being used for the purpose. An oil can should never be used for this purpose, as too much oil may be so dropped onto the pins and the bobbins soiled beyond future use.

New Warp Orders

When the operative receives an order to make a somewhat different warp, it does not mean that the ends should be cut from the cross reed, as such a course is entirely unnecessary. The new ends should be tied to the old ones, and if there is no change in the cross reed the ends may be simply pulled through. In case there be a change the new ends will have to be reeded anew.

Different Space Reeding

In constructing long and heavy warps on the plain straight horizontal machine, the reeding operation differs somewhat from that used in constructing lighter warps. The knowledge of the proper way to reed such warps accurately is best attained after the first section is made, as much depends upon how much this section spreads.

The Construction of Warps Containing More Ends in Pattern than Pins on the Creel

In constructing a warp containing more ends in the pattern than pins on the creel, the first half should be banked and wound on the reel. The second half of the pattern should be reversed by turning the spacing reed bottom side up, providing existent conditions will permit. The proper accomplishment of such a course will save time in the tying up of the bobbins for the second half of the pattern.

The operative should keep well in mind the fact that the cross must be made the reverse way of the previous section, as the first section will be made with a cross first up and then down, and the next section will have to be made first down and then up. The second half of the section will run through the space reed having a half turn. This operation will prove to be a trifle difficult to the beginner, but with patience and good judgment it can be eventually accomplished. Again, the successful accomplishment of this method marks the skilled operative and puts him in a class by himself. If not attempted at all, the loss of considerable time will result in the tying up the bobbins and spacing the second half of the pattern.

Hazardous Figuring

While accuracy is demanded in practical warping operations, too much figuring in the matter of the quantity of yarns to be used for a warp, and other exactions in this respect, are marks of poor management, for such methods stand in the way of the turning out of a perfect warp on the part of the operative. In other words, paring down methods in ninety-nine cases out of a hundred provoke trouble. The department head, before giving his orders for the warps he wishes constructed, should make sure that yarns in sufficient quantity to complete the warp have been supplied to the operative, and particularly so when warps of a complicated nature are to be made.

There are many things to take into consideration when figuring a warp and often important items are overlooked. For instance, even if a suitable amount is allowed, it very often occurs

that sufficient quantities of yarns are not on hand or have not been ordered. The blame for this shortage falls wrongfully on those whose work it is to handle the yarns, and so dissatisfaction is brought about which could easily have been avoided had proper methods been pursued.

In calculating the quantity of yarns it takes to make a certain warp, the matter of the difference in the piling up of the warp on the reel is not always well considered, an error which can usually be traced to the order clerk who lacks experience or has not been properly instructed in warping details. Naturally, the longer and heavier the warp under construction the more allowance should be made, and it should be borne well in mind that the smaller the reel the more the warp will pile up. When making lighter and shorter warps the difference is not so noticeable as in the case of the heavier sorts.

Very often, the heavy warps pile up in such a manner as to result in much longer warps that the machine is set for or the order demands. In consequence, as there has been no allowance made for this piling up tendency, a yarn shortage ensues which prevents the completion of the warp and operations have to be suspended until additional yarn is supplied. Again, there is no assurance that the additional yarn supplied will be the exact shade that has been worked in the warp, and a color difference of this kind is bound to result in imperfect and streaky warps.

Furthermore, it is unwise to practice too much economy in yarn cost, as warps constructed under these conditions invariably have to be worked in small sections, which, in turn, brings about objectionable lapping and crossed ends which interfere with perfect weaving, to say nothing of additional labor, time and cost. All of which makes plain the point that a generous, but rational, yarn allowance in warp construction brings about better results in the long run than a niggardly managerial policy.

Increased Length of Warps, Due to Increased Circumference

Warping machines are not so perfected as to deliver the exact yardage for which they are set. A warp of 4800 ends, 60/2 cotton, 30 inches wide, was made on a Swiss-motion warping

machine, with the use of the elevation irons, on what is known as a 2 meter reel, the circumference of which was found to measure $85\frac{1}{2}$ inches.

The dial was set for 202 meters, but the warp, when finished, measured 215 meters. While making the warp, it was found to make 93 revolutions of the reel before reaching this mark. By simple calculation, 93 revolutions of $85\frac{1}{2}$ inches each would make the desired length of 202 meters, the dial revolving according to the revolutions made by the reel, registering accordingly. But it has not been considered that with every turn of the reel the circumference of yarn increases, since each succeeding round laps over the preceding one, making the last lap of the section considerably longer than the first (in this case 94 inches), and the longer the warp, the greater the difference will be between the actual length and the setting of the dial. The size of the material and the number of ends in the warp will also add to this difference, since the coarser the material and the greater the bulk, the sooner the warp will pile up, making each revolution enlarge and gain in length so much the quicker. The reel, in the above case, had been adjusted for finer-sized material than the 60/2 cotton of which the warp was made.

The following examples show the actual length of some cotton warps made on a Swiss machine set for 202 meters:

Material.	Ends.	Width.	Actual Length.
100/2 cotton	3108	30 inches	206 meters
80/2 "	4800	30 "	210 "
60/2 "	4800	30 "	215 "

The size of the reel must also be considered. A warp made on a horizontal machine, for instance, being a larger reel (8 yards), will not require as many revolutions as that of a Swiss machine, and, therefore, will not differ as much in length. The larger the reel, the smaller the difference gained in the length of a warp.

Careless Methods

Much can be said on this point, as it is, perhaps, the most difficult thing to contend with in warping operations. The worst trait of an operative is inattention to the work in hand,

which usually takes the form of engaging in conversation with fellow operatives, thus accomplishing the doubly bad result of distracting the attention of the latter as well as that of his own, from the work in hand. This sort of thing is one of the worst of warping room evils and the operatives should realize (and, in case they do not, should be made to realize) that close attention to their work is absolutely necessary if satisfactory results are to be obtained.

Ends must be carefully and continuously watched so that the necessary picking and cleaning, that all warps require, can be properly accomplished. If these details are not carefully looked after, ends are lost and left out, knots and lumps get into the warps, and other mishaps are liable to occur. The ordinary excuses made by operatives, when called to task for careless work in this respect, are not usually accepted by those in charge, and rightly so. If at any time an occasion arises when the warping operative cannot give his entire attention to the work in hand, the best thing for him to do is to stop the machine, and so minimize the chance of defective work.

Strong draughts in warping rooms are to be avoided if it is possible to do so, for, under such conditions, when the ends of a partially finished warp are slackened they will be blown about so that they twist and snarl around the pins and bobbins, and, when they are again drawn tight, a smash is often the result. Draughts are particularly detrimental to the construction of pure dye warps, as silk yarns of this description invariably possess fluffy and scattering tendencies.

Memorandum Book

Warping operatives of the best class keep records of all the warps they construct, embracing all details and these, written, in a memorandum book, a course which is strongly recommended to those taking up this branch of silk fabric construction. Some operatives adopt the very bad plan of using pieces of paper for memoranda of their work, but, as these are easily lost or destroyed, their records are incomplete, and many invaluable points of warp construction, for future reference, are lost to them.

A well-kept memorandum book, such as is described, is invaluable to operatives who are given repeat orders on certain warps, saving both time and labor. It gives an opportunity to make complete records of dispositions and cut-down warps, so that, if at any time a question arises concerning the details of some particular warp, such as sections and ends, the previous record of a similar warp is at the elbow, so to speak, of the operative.

A simple form of record for the warping memorandum book is presented herewith. For example, take 5376 ends. The proper way to handle such a record is to jot down the ends in each section as it is completed. The sections should, of course, be differentiated by numbers.

Date.....
Warp Number.....
Disposition Number.....
Beams.....
Color.....
Stock.....
Width.....
Length.....
Cut Marks.....

10	**Sections**	**—300 ends**	**=3000 ends**
10	**"**	**—200 "**	**=2000 "**
3	**"**	**—100 "**	**= 300 "**
1	**Section**	**— 76 "**	**= 76 "**
	Total.....		**5376 ends**

The Quality and Quantity of Beaming Paper

In this matter opinions often differ widely regarding the quality of paper stock that should best be used. There are many grades of such paper, but experience has taught that, in the long run, it pays to use the best obtainable. Good judgment is demanded on the part of the operative to make use of sufficient beaming paper for the construction of the warp. The heavier the warp the more required. It should also be borne in mind that at the commencement of a warp considerable paper is required and the

quantity is gradually lessened as the operations proceed and the warp nears its completion.

The Duties of the Order Clerk

In recording warp orders and dispositions, it is a common error on the part of order clerks to use abbreviations and numerals instead of writing out the necessary instructions in full as should invariably be done. By pursuing this bad method they leave the way open for misunderstandings and mistakes. Being quite familiar with this branch of the work they find it much simpler, and certainly quicker, to make out warp orders using abbreviated terms. An order of this description, when delivered to the warping department may not be understood by the person in charge, which, in turn, necessitates the seeking out of the order clerk in order to obtain a clear understanding of what is required, all of which consumes time and can easily be obviated by properly filled out order forms.

Again, it often so happens that the order ticket is misplaced by the operative, in which case, if the order clerk is exact in his methods, a duplicate order can be immediately issued and time saved. Clearness in giving instructions, especially in case of unfamiliar and complicated warps, is one of the prime duties of the order clerk in a modern warping department. Operatives cannot be held responsible for mistakes which are made because of misdirections.

The foreman, who, after all, is the one who should be held responsible by the head, if the warps are not properly constructed, should make it his business to demand that all order tickets handed him be plainly, completely and legibly written. A good point for the order clerk to observe is that, in writing orders for disposition warps, it is a far better practice to use the words " single," " double " or " triple," as the case may be instead of using numerals.

Avoidable Mistakes

When a mistake is made in warping operations, and remains undiscovered until the warp is completed or partly completed, the operative should keep his head and make every effort to find the

proper remedy for his mishap. Often, mistakes are made which are very difficult to surmount. In cases of this sort, experience and good judgment are very necessary attributes for the operative to possess. However, in the majority of cases, mistakes can be remedied, so that, at the worst, the warp can be utilized in some way.

Such results are often brought about by the addition of more yarn, picking a different cross, and the utilization of the hand-picking frame to obtain a different width. Often mistakes can be repaired in the twisting operation. However, a great deal depends upon the nature of the mistake, the different contingencies which arise needing different handling. In many cases, means can be found by which mistakes in warp construction can be remedied and this, perhaps, with slight, or no extra cost. A mistake once made should be thoroughly investigated by the person in charge before the blame is placed.

Short and Long Sections in Horizontal Warping

Two of the most dreaded evils of warping operations are what are known as short and long sections, in horizontal warping, and which are largely due to carelessness on the part of the operative in not properly setting and regulating the machine, or the premature cutting off of sections.

Warping machines are made with a measuring device, and an indicator also, with a bell attached. The bell is for the purpose of giving an alarm when near the end, before cutting off a section. The bell works automatically with the running parts of the machine. Therefore, if the indicator is set properly there will be no danger of making short or long sections, at any kind of warping. The operatives as a rule, nine times out of ten, blame the machine as being out of order when they don't understand that it is unintentionally their own fault, when they have made short or long bands, or sections. The following are some of their faults:

1. Usually, after planning the making of a warp, the main cause of making short sections is that the operative forgets to set the measuring indicator properly before starting to wind the section on the reel.

2. Cutting a section off before the indicator rings the bell for a warning to stop the machine.

3. Turning the reel around after the indicator is set and before the section is hooked on the reel.

4. If, in a warping room where there are a number of warping machines running, the operative hears the bell of some other machine ring and thinks it is at the machine he is working at, then, without thinking or investigating, he may cut off, and, by this mistake, leave a short section.

5. By the operative being suddenly interrupted, or his attention attracted with talking, or by some other means, when he may thoughtlessly cut off, not thinking of the short or long section he may be making.

6. It may happen that ends break out after the bell rings and then the machine is stopped, which is right. Then the operator repairs the broken ends, but, without thinking of cutting off, starts the machine running again, which causes a long section.

The repairing of one or more long sections is a simple operation, and is accomplished by first cutting the lease cord and then beaming the long section on the beam with the balance of the warp, an operation which results in the separating of the long section or sections from the others. The tension weights are then released, and the long section is wound on the beam until the cross is reached. The cross rods are placed in the long section which is then wound back on the reel by reversing the power of the friction pulley at the reel. The same result is got by turning the reel back with the hand, and, at the same time, carefully turning the cross through its proper place in the warp, which operation enables the operative to cut off the over-run length of the long section, or sections, for waste.

A short section is more difficult to repair and considerable study should be given to the situation by the operative so that he can ascertain the best and easiest way to go about the work. If there are enough bobbins remaining on the creel, corresponding with the number of ends in the short section, repairs can be made by turning the reel backwards, loosening the warp and tension weights, and removing the short section back to the carriage. The cross is then secured with a short cord and the short section

can be separated from the warp proper. The operation is continued by placing the cross rods in the short sections which are fastened on the reel. A cross is made in the section that is to be pieced in such a manner as to bring the two crosses together so that each end can be tied individually.

In some cases, it is not advisable to adopt this course, as the section can be more conveniently repaired at the loom by making the pieced section on a separate beam. In other cases this method does not pay at all, for it may so turn out that, by simply placing the cross rods in the lease, working the cross back so that it meets with the cross in the short section, and tying these together, the wasted sections may be cut off, which, of course, are figured as a loss.

In the operation of Swiss warping, long sections, which are to be repaired, are treated about in the same manner, but in the case of short sections the warp is usually cut off to fit the short section, which reduces the loss owing to the smaller reel and shorter length.

The Matter of Waste on Bobbins

Operatives sometime develop the bad habit of removing bobbins from the creel which still have too much yarn on them to be so wasted. This type of workman will bear watching, as such methods lead to the accumulation of considerable waste in a very short time. The practice is, perhaps, largely accounted for in the running out of many bobbins at the same time, which, of course, must be replaced with full bobbins. The rule should be rigidly adhered to that the yarn on all the bobbins must be run off clean. If this be done, operatives will be made to realize the costly yarn waste which occurs from nothing but sheer carelessness.

Treadle Strain

Operatives of slight physique, when using the tread pedal to run the horizontal machine, even with easily-running yarns, very often find that the operation is tiresome and more or less of a muscular strain. This may be offset by the use of a stick long enough to reach from under the carriage table to the lower part of the

tread pedal when it is pressed down. The stick may then be propped under the carriage table.

Experienced operatives make use of this method by tying a cord to the upper end of the stick, by which means it is fastened under the table, thus placing the stick within handy reach. The stick may be brought into use by pressing the pedal down with the foot so that it may be adjusted in a position between the carriage table and pedal. Slight pressure on the pedal will release and move the stick, causing immediate stoppage to the machine. The same arrangement can be applied to the beaming pedal when a warp is being beamed.

Inexperienced Operatives

Many applicants for positions in warping plants claim to be experienced operatives, but their lack of skill is soon ascertained when they are placed on the machines. The claim that they are skilled in warping operations is not substantiated by results. However, this is not to be wondered at as no two mills in the warping branch of the industry employ the same methods. Some applicants, who have been engaged in warping operations for years, possess but the rudimentary knowledge of tying up, and the starting and stoppage of the machine, which limited equipment, in many cases, has been acquired from some other warping operative, who, in turn, possessed but a limited knowledge of the business obtained by working on plain simple warps.

Many applicants present themselves for positions as warpers whose experience has been strictly limited to plain and simple warps. When such are given a warp to construct, possessing unfamiliar details, it generally results in a request for assistance from other operatives. The possession of good rudimentary knowledge, however, sometimes offsets a lack of experience in the construction of more complicated warps. An operative of this description can be easily and well taught, and so, in time, become a reliable workman. The ability to take in hand and construct every sort of warp used in the weaving end of the industry requires an experience of many years, and such warping operatives can always find positions.

Sample Warps Made on the Horizontal Machine

In making short sample warps on the horizontal machines, the reel of which possesses no special arrangement on which to hook the finished section ends, temporary wire hooks should be made and utilized. These are bent and fitted so that they will clasp on the slat of the warp reel nearest to the length of warp which is to be constructed. These useful makeshifts can easily be removed and laid aside for future use.

Ombré Warps

In this delicate warping operation, the best plan to pursue by the foreman is to give but one color at a time to the operative with careful instructions for treatment, repeating this method for each designated color until the warp construction is completed. The number of bobbins required, and the quantity of yarns to be wound on each bobbin, should not only be carefully pointed out to the operative but the bobbins for each shade of the warp should bear a distinguishing mark of some description. In some establishments the color number is plainly marked on the bobbin, while others make use of gummed labels carrying numbers. The use of either one of these methods eliminates the danger of the mixing of colors in the building of this exacting class of warp.

The Handling of Swiss Warping Machines

If the equipment of a warping department or warping plant consists only of the regular Swiss machines, the best course to pursue is to relegate the beaming to a male operative. Many plants, so equipped, also make use of the services of an assistant in lifting operations, and so doing away with the beaming of the warps on the part of the operatives. This method necessitates the stoppage of the warping machine during beaming operations, unless spare reels have been provided, which should always be the case. In small plants, if there is not sufficient beaming work to keep the beamer and assistant busy during the working day, their services can be made use of in various other ways such as in cleaning up and keeping the department or mill in order, repairing and

oiling machinery, delivering warps, collecting empty beams, and the handling and distribution of beaming paper.

The Beaming Machine

The beaming machine is a device in itself and separate from the warping machine and is only used for the beaming of warps that are constructed on the regular Swiss warping machines, and then only when the warp is completed. When finished, the reel and warp are lifted out of the warping machine by two male operatives, and placed by them in the beaming machine. The beaming operative centers the warp so that it fits on the beam, which operation is, in turn, accomplished by turning the worm-screw supplied for the purpose.

One end of a cloth apron is then tacked on the beam, and a thin iron rod is inserted in the opposite end of the apron. For this purpose, several slits or holes are placed in the end of the apron where the rod is inserted, being so placed for the purpose of fastening the ends of the sections through the slits so that they can be tied to the rod, and used for the operation of winding the warp on the beam. As the warp winds from the reel, sheets of beaming paper, are, from time to time, placed on the beam with the warp thus winding up with it, so that the latter may be held tightly in place. Heavy and long warps, fashioned of coarse material, can be beamed off on flange beams that are made especially for this purpose. It is not necessary to use beaming paper for this class of beam.

The details of the various operations required in the beaming of the different warps are only acquired by the operative after years of experience. The successful workman in this branch must give his undivided attention to his task, and make use of sound judgment practically every minute of his time. This is especially so when the warp is being beamed, for a constant watch must be kept on the rod placed between the reel and beam, which, in turn, will rise should there be any threads of the warp which catch while beaming. The raising of the rod by these sticky ends is a warning to the operator to immediately stop the machine and repair the threads.

As there is no fixed method for regulating or governing the tension straps, the operative must make use of his best judgment and skill so that the warp is not beamed too loose or too tight. His attention should be concentrated on the warp while beaming until the operation is completed, as he has many things to contend with, such as "wringers," or, long and short ends, which require skill to repair. When he is quite satisfied that the warp is beamed

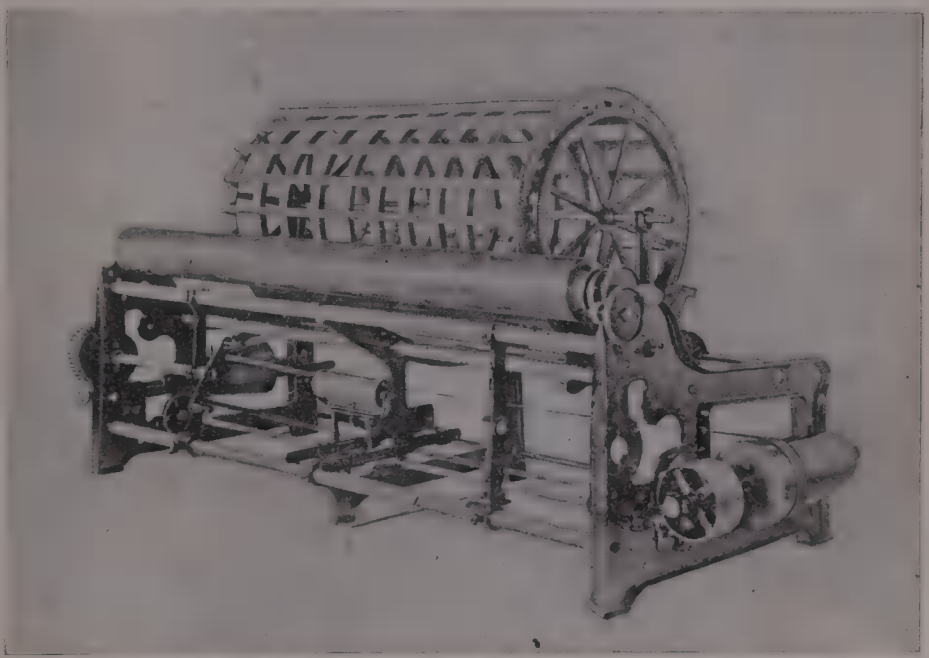


FIG. 12.—Swiss Beaming Machine, and Empty Reel.

correctly, he should loosen the sections from the reel and twist them slightly together on the beam. The warp should then be completely wrapped in paper and corded at the center and at each end. The required piecing bobbins are attached, and the warp is thus completed and is now ready for the loom.

Warping with a Low Grade of Silk

In a mill where a low grade of silk is being used to make warps on the regular Swiss machine, it will be best to have plenty of space, at least 7 or 8 feet, between the creel and cross reed, and

very slow speed, running from 10 to 14 yards per minute, so that the picking, cleaning and tying of the knots can be done without stopping the machine. This requires good experienced warper operatives, and an assistant who is learning.

The operative must have considerable patience and good humor, and also possess good eyesight, so as to be able to give the necessary attention that the warp needs in such important details as the picking and cleaning of all imperfections from the yarn, and delivering perfect warps to the loom, so that there will be no trouble in weaving perfect fabrics so far as warping workmanship is concerned.

Picking the Warp

In this operation, the warper is expected to remove from the warp all imperfections of a sufficiently serious character as to cause blemishes to appear in the fabric when woven. Such defects will be slugs, or thick lumps in the yarn; bad winders' knots, either too bulky, or with long ends; split ends, where the warp threads have been partly cut through; very coarse ends, or doubled ends, where a thread is grossly thicker than the average of the warp; very fine ends, where the thread is so attenuated that it would be certain to break down in the weaving; and, in general, all imperfections of a serious character. High-class silk, well thrown, requires but little picking, whereas with poor silk, and poor throwing, the labor is increased, with a conesquent increase in the time taken in making a warp. The picking requires the closest attention on the part of the operative, coupled with great manual dexterity, and, to turn out a perfect warp, much skill and good judgment must here be used.

The methods of picking the warp will vary according to the types of the warping machines used. In Swiss warping, as each section slowly winds on the reel, the operative, as she sees the imperfections traveling down the threads from the creel to the reel, leans over, takes the thread at the imperfect place between her finger and thumb, draws the thread up (the bobbin of course giving off the necessary slack yarn), and then ties a knot in the doubled or looped thread, below the place where the damage is, clipping off neatly with her scissors the loop with the damaged

part in. She then drops the end, the movement of the reel immediately straightening out the thread. If the warp is made of good, clean material, she will be able to do the picking without stopping the machine, attending to each imperfection as it appears, and making her knot, and clipping off while the threads are in motion. If, however, the imperfections are too numerous for this, she will stop the movement of the reel by pressing her foot on a pedal, and then, after cleaning off the imperfections that are before her, will start the reel again by releasing the pedal. It is astonishing how clever some warpers are, and the rapidity and accuracy with which they can clean a warp while the machine is in motion, and do it well. The cleaning can be done from either side of the warp as may be most convenient, and the picking is done on that expanse of warp between the creel reed and the cross reed. Where very little cleaning is to be done, the reel can be run correspondingly faster.

On the horizontal warping mills, the picking is done during the beaming process, where the entire number of warp threads are in view. In this picking, there is the disadvantage that the threads are under tension, so that, when an imperfection is broken out, a length of piecing yarn must be used and two knots tied, the second knot having to be done under tension, and much skill is required to do it properly, a skill by no means always shown. In this piecing-up of the threads, a special draw knot should be used to avoid leaving slack ends in the warp. Also, where the threads are thus concentrated, instead of being spread out as during their passage from the bobbins, a great many imperfections are liable to be buried in the warp and not seen, turning up later to make trouble for the weaver and to cut down the production of the loom.

Another method in picking, and one which has much to commend it, is to do no picking at all in the **warping** process, it being therefore, practicable to run the warping and beaming at a higher rate of speed. After the warp has been beamed, it is then put onto a carriage, or frame, and is then rebeamed onto another beam mounted on another frame, or carriage, the two being a short distance apart, say, 8 to 10 feet. One of these beams driven by power, winds up slowly, the other one giving off the warp,

and the operative who does the picking, or cleaning, stands beside it and carefully removes the imperfections from the warp as they come into view. The speed will be as slow or as fast as is warranted by circumstances, and, as there is no compulsion as to the time to be taken, the warp can in this way be cleaned in a most thorough manner. In cleaning during the warping, if too much time is taken, the warping will fall behind the production of the looms, whereas this separate cleaning permits the warping machines

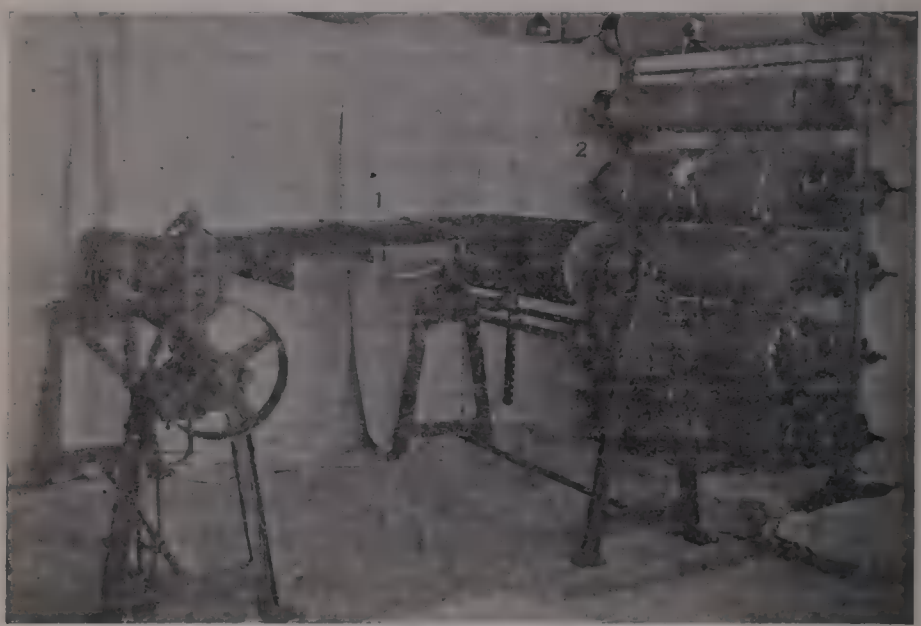


FIG. 13.—1. A warp ready for picking, in a power picking frame. 2. Finished warps, placed in an iron warp-rack.

to run even faster. Also, the cost is not greater, and really is less, for the cleaning of the warp must be done anyhow, and, in this separate picking, it is done to greater advantage than at the warping mill, and every imperfection which is removed, that otherwise would cause a thread to break down in weaving, increases the loom production in the weaving by just that much. No effort or expense should be spared to make the warps as clean and as perfect as possible.

Damaged Warping Reeds

One of the causes of defective threads in a warp is often found to be due to worn blades in the warping reed. The friction of the threads against the worn reed blades wears a groove in the blades, which tends to scrape and damage the threads. If the latest improved reed motions are not used, it will be advisable to examine the space and cross reeds occasionally, to see if there are any worn or grooved blades. Some reeds last longer than others, but it largely depends upon the yarns used in the warps. If the reeds are not worn very much, they can be repaired, otherwise they will have to be renewed. It is advisable to have all warping reeds nickel plated, so as to avoid rusting of the reed blades, which often causes soiled marks in white and light-colored warps. In winding, quilling, and doubling operations, yarns are often damaged from running through worn and grooved guides, caused by the friction of the threads. All guides should be examined frequently, and, if worn, removed at once.

Importance of the Lease

It is really interesting to know how a warp of thousands of threads, and any required length, is leased with a cross, being thus built and bound together so that each end can be separated from the others without tangling. It would be impossible to manufacture the quantities of fabrics that are used, without the lease or cross cord, especially those made of silk or other fine yarns.

Treatment of White Yarns

White and delicate shades of yarn, after being received from the bleachers and dyers, should be handled with the greatest of care. Every skein should be examined thoroughly and all soiled skeins laid aside to be used in other fabrics where the warp or filling covers the soiled spots, or when they cannot be seen in the pattern. The skeins should be carefully selected before they are given to the winder operative, and should be well covered and protected from dust and dirt. The operative should be supplied with every accessory to cleanliness, such as soap, towel, French

chalk, powder, etc., so there will be no excuse for handling the material with soiled or moist hands. When these precautions are taken, the work will be clean, although every operative cannot be trusted to wind white yarns. The machinery should be frequently examined to see that all spindles, swifts and, especially, the bobbins, are clean. If the wound bobbins are to be stored, each bobbin should be wrapped in white tissue paper. Yarns for immediate use should be carefully placed in baskets or boxes, covered well, and delivered to the next operative who is to handle it.

There are many ways in which white and light shades are soiled in warping, beaming and quilling operations. Very often poor work is quite unintentional, and is due to ignorance and carelessness on the part of a beginner. Foremen should keep a sharp eye on this class of operatives.

Careless Warper Operatives

Naturally, everything has to be handled with the utmost care in a warping room. Some warper operatives are careless about handling parts of the machinery without washing their hands before handling light-colored yarns, thereby soiling same and causing irretrievable damage. Very often the reeds are at fault, being unclean or rusty, conditions which cannot be rectified too quickly.

When loosing ends from the reeds and pulling back to so find and repair them, it is very dangerous to omit the free use of French chalk on the hands. Rather than take the chance of soiling the white yarns, the ends of the section should be lapped after they are drawn through the reeds. The sections of a warp should not be allowed to stand any unreasonable length of time, as they will show dust marks. In tying knots, the ends should never be bitten off, as soiled knots will invariably result from the practice. The warp reel should be well covered and care should also be taken to keep the warp well covered when in the building. Paper should be wound around the reel over the warp so that it can be slid on the warp in process.

The apron worn by the woman operative to protect her clothes, and often made use of by her for the wiping of soiled hands and, perhaps, machinery parts, is frequently responsible for soiled

white warps. Foremen should insist upon the use of clean aprons in the warping room.

There are also numerous ways in which white and light shades of yarns are soiled in quilling or spooling operations. In many cases the trouble may be due to complicated, and fast-speeded machinery, or to the amount of handling that the yarn is exposed to.

After every effort has been made in the various departments to deliver clean yarns, there are numerous accidents at the loom that frequently result in soiled fabrics. Often the trouble is not detected while weaving, but still appears in the woven fabric, and it is then hard to determine the direct cause of soiled threads, spots and streaks. Naturally, the weaver, to free himself from blame, claims that the warp or filling, as the case might be, was soiled before he received it from the warping or winding room. Every mill manufacturing white and light shades should treat these separately from other colors, and this throughout all the processes from the winding to the finished fabrics.

White fabrics can be manufactured perfectly at times in some mills, but perfect white fabrics can rarely be manufactured at all times in any mill. Those who thoroughly understand silk textile operations, and have had wide experience, are familiar with the different processes and treatments that white yarns must undergo before they become the finished fabric. Veteran operatives on white yarns endeavor to produce perfect goods at all times, but it seems to be an utter impossibility to prevent soiling. Every operative who has to do with white yarn should be constantly warned by those in charge, and so lessen the possibility of soiling, and this care should be maintained in all stages from the winding to the finished fabric.

Making Use of Old Yarn Lots in Warps

There are various ways to mix old lots, and remnants of a color, when necessary to use them in a warp for mixed or figured fabrics. When good judgment and common sense are used in mixing the color, there is no danger of streaky warps. But in plain warps, no matter how carefully the color is mixed, there is

always some danger of the warp turning out a streaky warp. Sometimes this mixing is done so that use may be made of old lots or remnants, but if there is too great a difference in the color matching there is always the possibility of a streaky warp; but if the colors are a true match and are properly mixed, and if, after the beginning of the first section, the warp is examined and appears even, the warp can be finished without fear of streakiness.

There are times when streaks are not discovered until the warp is completed, and then there is apparently no cause for them. But if it is traced properly, the cause may be found to be either due to carelessness in mixing the yarns, uneven dyeing, or irregular winding. It very often occurs that yarn is wound soft on the bobbins by some operatives and hard by others. If these are not properly mixed, streaky warps will be the result. But if this defect is known when the warper receives the bobbins, the warper operative should be given instructions just how to mix them, and, by accomplishing this properly, the streaky defects will be eliminated.

It depends largely upon circumstances as to just when remnants can best be used and the proper way to mix them. If there are two or three lots of the same color intended for one or more warps, it is best to bank and tie up end-and-end throughout the entire creel, and, especially, if there is an equal number of bobbins and weight of silk in each lot. The bobbins should not be arranged so that the full bobbins are on one side and the empty, or partly empty, ones on the other side of the creel, as this will cause the bobbins to run out as emptied which have to be replaced with bobbins of a different lot, invariably causing streaky warps. This is one of the important things for the operative to remember in order to keep the bobbins uniformly scattered.

To indicate the difference between the bobbins when they run out, each lot should be marked with chalk, so it can easily be seen which lot to replace when necessary. It is not always best, in all cases, to follow the rule of mixing the colors end-and-end, as, if the difference in the colors will permit, they can be mixed in proportion to the amount of material there is to be used. If there are only one-quarter as many of one lot of a material as of another, and the bobbins are properly filled, naturally they can be tied,

one end of the smaller lot to three or more ends of the larger, and so it will be in all similar cases.

It is a very simple matter to give instructions to the operative to mix end-and-end, and not to take into consideration the number of bobbins it requires to fill the creel. Should the operative follow such instructions, one lot may run out before the entire creel is banked and, not knowing of the danger, the operator banks the rest of the creel with one lot. The result is a streaky warp,

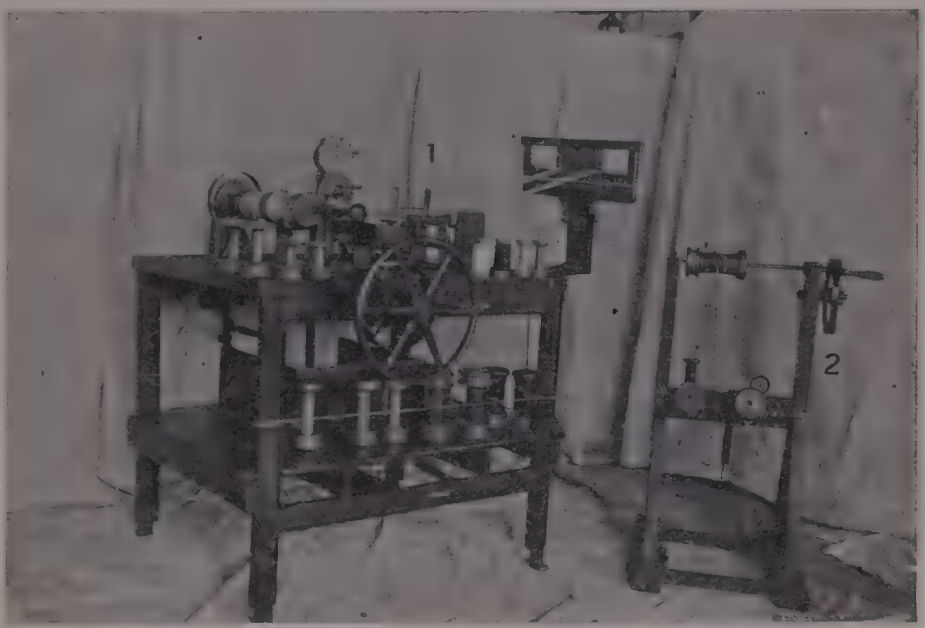


FIG. 14.—1. Edge-warping machine and anchor bobbins. 2. Hand-drive edge take-off machine.

which defect is very seldom discovered until the warp is completed or partly so, and, if the operative is called to account, she invariably does not understand why she was at fault. Nine times out of ten it is not until she explains how the creel was banked, that the mistake is discovered.

Selvages, Edges, or Binders

Selvages and edges are made and used with all warps. With some warps, the selvages are constructed simultaneously on each

side, and usually are made of double threads of the same material as the warp. Other warps require separate edges, a trifle longer (from 5 to 20 per cent) than the warp. These are wound on bobbins made especially for this purpose, which are very strong and heavy, with a groove on one or both heads or flanges for holding the tension cords when using the edges with the warps. These are commonly called anchor bobbins.

Edges are made in various ways and are of different kinds. In order to get the required result, some are made with heavier material than the warp, the selection naturally depending upon the fabric to be woven. Some edges are made with one color, others have a fancy stripe, and there is considerable difference of opinion concerning the way in which they should be made.

Some warper operatives make the edges after completing the warp and wind them on the anchor bobbins by means of a mechanism made for this purpose, called the take-off machine.

Edges can be made in considerable quantities on the warp machine at one time, but in large mills the equipment includes a regular edge machine that winds and measures the length of one or two pairs of edges direct on the anchor bobbins. This machine can be operated by either a boy or girl.

Power and Speeds for Winding, Warping, Beaming and Quilling Machines

For this class of machinery, the individual or group electric drive is the most satisfactory and reliable, as well as the safest and cleanest. There is no absolute rule for the exact speed at which these machines should be driven. Experience and careful trials usually determine what rate of speed is suitable for the material.

A skein-winding machine is driven with step-cone pulleys, one from the line shaft and one on the machine; by shifting the belt one way or the other on the cone pulleys, the desired speed can be obtained. This arrangement is considered the old way.

When the machine is of the type that is driven direct from the line shaft, arranged with variable speed-friction pulley, it is considered as driven the new way. The pulleys can be more easily and quickly adjusted than by any other arrangement which is

workable to obtain any speed required for winding all grades of material.

The horizontal warping machine requires two different driving motions, one direct from the line shaft to the beamer gear wheels to do the beaming, and the other with the warp reel driven from the beamer drive with two grooved disk pulleys and friction, by means of a flange secured to the side of the reel, which is driven and comes in contact with a friction pulley that is carried on a lever and operated by the use of a treadle. This will provide the power and control the speed, and it is proper to run the machine at the rate of 70 to 80 yards per minute, and this will limit the beaming rate of speed to from 4 to 8 yards at the start of the beaming, for, as the warp winds and builds up on the beam, the speed invariably increases.

A regular Swiss warping machine, and a beamer machine, are separate, and are driven with step-cone pulleys so that they can be arranged to run at any speed that is required. The proper rate of speed should be from 6 to 30 meters per minute, as may suit the requirements of the material, either warping or beaming.

Makeshifts for the Horizontal Warping Machine

There are several things necessary with a horizontal warping machine which are not furnished when purchasing the machine, and these must be adjusted before the machine can be used to make a warp.

1. The entire quantity of bobbin pins should be numbered on the frame of the creel directly over each row of pins, with good plain figures.

2. A thin strip of wood about 3 inches wide, white upon one side, black upon the other, extending the full width of the creel, should be arranged directly underneath the glass reed, so that it can be easily reversed, to use either black or white, whenever necessary to plainly see the ends.

3. There should be a heavy wire about $7\frac{1}{2}$ inches long with a hook at each end to hold the cross reed on the creel when reeding.

4. There should also be a thin wire extending the full width of the cross-reed frame, so that a black or white cloth, or paper, may

be hung on the wire between the space and cross reeds, in order to see the ends plainly.

5. One or two wire hooks should be fastened on the side of the carriage to hold broken ends when pulling back the section.

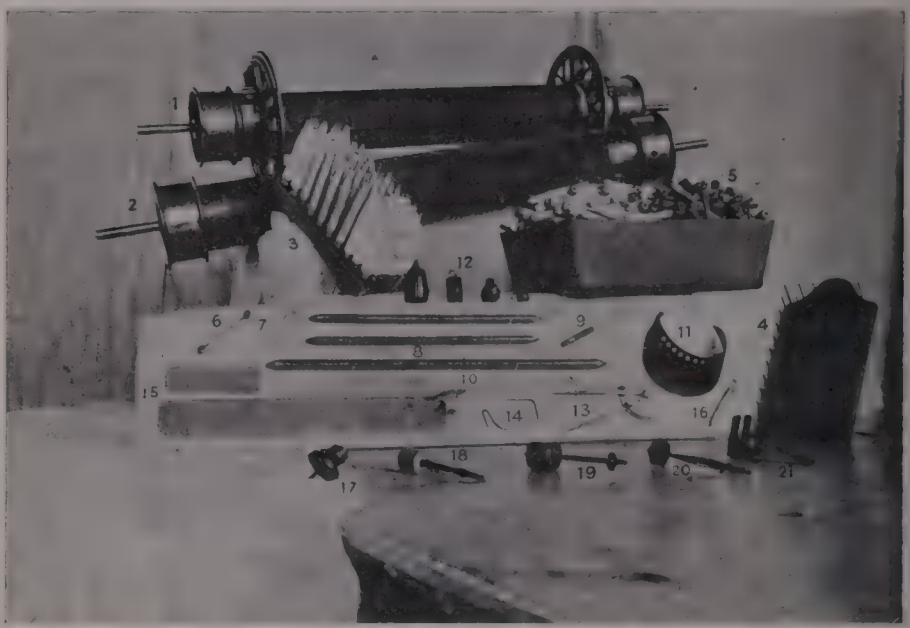


FIG 15.—1. Flanged warp beam, with rod and apron. 2. Warp beam, with beam heads, rod and apron. 3. Quill board with wound quills. 4. Quill board, empty. 5. Fibre box and full quills. 6. Fibre swift brace. 7. Endless cotton-cord swift braces. 8. Three crossing rods. 9. Reeding hook. 10. Cross-reed holder hook. 11. Eye shade. 12. Winder swift tension weights. 13. Section spacing compass. 14. Section hook for sample warps. 15. Black, and white, strips for reed background. 16. Bone pick. 17. Doubler flyer guide. 18. Winder spindle, with wooden head. 19. Doubler spindle for take-up bobbin. 20. Quiller spindle with grooved head. 21. Iron bracket device for stopping bobbins from winding too full.

6. There should be six bobbin pins on the front of the carriage to hold different color piecing bobbins.

7. There should be a pin under the carriage table to hold a bobbin containing crossing cord.

8. There should be a narrow strap or rope for a brake, and tension weights, to control the reel when winding a section.

9. A row of bobbin pins, used for holding piecing bobbins, should be arranged on the frame extending the full width of the reel, and about 3 feet above the beaming device.

10. A wire or cord should extend the full width of the frame under the warp when beaming, to fasten a black or white cloth or paper to for a background.

11. A roller, as long as the width of the reel, with a cloth attached for covering the warp when not working, should be arranged on the frame under the beaming device. The cloth should be about 9 yards long and may be rolled up when not in use.

12. There should be a rope, strap or chain about 2 feet long with a loop at each end and a heavy iron pin, or square-head lag screw, to attach to the beam on the beaming device.

13. There should be special wire-section hooks, to hang on the reel slats for short sample warps.

Necessary Tools for Warping

1. A strip of good, smooth, stiff, cardboard paper, $2\frac{1}{2} \times 8$ inches, black on one side, white on the other, to be used for a background when reeding.

2. Pencil and Chalk
3. Memorandum Book
4. Two-foot Rule
5. Reeding Hook
6. Dividing Compass
7. Small Monkey Wrench
8. Scissors
9. Bone Pick
10. Screw-driver

CHAPTER IV

QUILLING PROCESSES

Quilling

In general, the process of quilling is the winding of the yarns on the shuttle bobbins, commonly termed quills. This is an important process and needs the greatest attention in order to attain perfect work and prevent unnecessary waste.

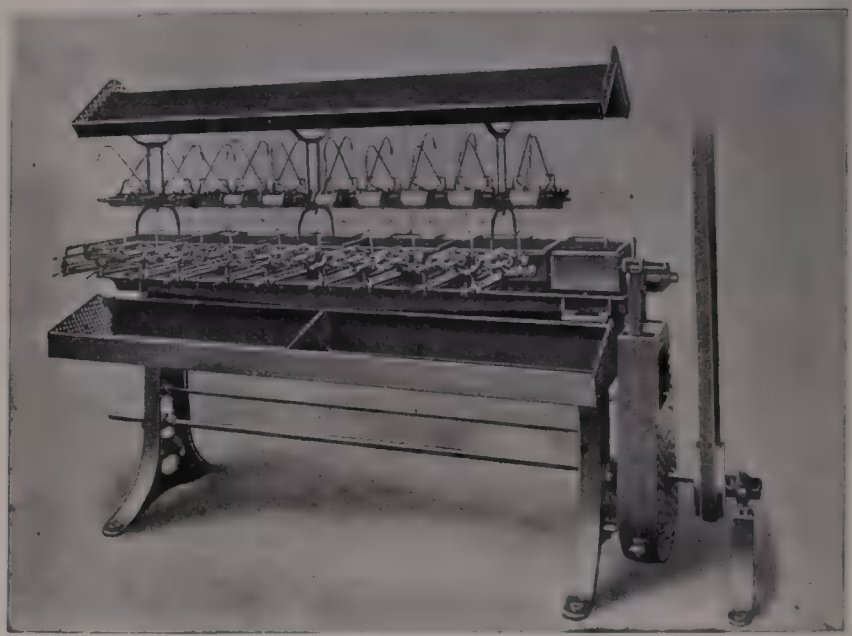


Fig. 16.—High-speed, Underdrive, Quiller.

In this process, great care must be paid to small details, which, if overlooked, cause trouble, such as soft or hard quills, quills wound too full or not full enough, soiled white yarns, or other things, caused by neglecting machinery repair and the carelessness of operatives.

Quill winding is a very simple operation, but there are many different makes of quilling machines, some quite simple and others more complicated. All are easily operated, however, as each spindle is arranged to run separately.

The spindle is set and regulated to make the quill the required size and length, so that, when it is full, it stops automatically by means of the stopper device.

The number of spindles to which an operative can give careful attention depends largely upon the yarn, the speed of the machine, and the length of the quill. Naturally, fine yarn fills the quills much more slowly than is the case when coarse yarn is being worked. An operative can, of course, give her attention to more ends when quilling fine yarns than is the case when coarse yarns are running on the machine; on the other hand, more work is attached to coarse-size quilling, as the quills fill up very quickly.

Fast speed is of the greatest importance to a quilling machine. There are very many different makes and no two of them are driven at the same rate of speed. Some are made to quill or wind the most tender material that can be woven, at a rate of speed of from two to six thousand revolutions of the quill per minute.

The operative has many little details to look after, and sometimes real problems to contend with in the working day, but these must be met and solved if satisfactory work is to be turned in. The experienced girl starts the quill in neat and proper manner; she does not leave stringy and snarly ends on the heads of the quills; she ties good knots when it is necessary to tie broken ends; she does not bite or tear the ends, but habitually makes use of scissors and uses great care when working with white or light-colored yarns.

There is no rule governing the regularity of the tension of quills, which can only be determined correctly by the sense of feeling and by examining them; therefore, good judgment must be used as to their tightness. As there are many kinds and counts of yarns, each sort must be humored with the tension best in accord with its strength and other characteristics.

It is well enough to knot fine yarns when ends break, but it is not advisable to so treat coarse sizes, as it makes large and clumsy

knots which will not readily pass through the eye of the weaver's shuttle, causing imperfect work, reduction of yardage and waste.

The operative must keep well in mind that the slightest mistake made in colors, or in the matter of yarn sizes invariably results in a loss, as there is no possible way to remedy such errors, which are rarely discovered until the cloth is woven and examined.

How Quilling is Accomplished

In this operation, an empty quill is placed on the spindle and the yarn end attached to the quill from the bobbin. The thread is placed in the guide and the spindle allowed to run. When full, the quill is removed and another placed on the spindle.

One method of starting the thread on the quill is to pass a few turns around it near the head before placing it in an operative position. Another method is to put the empty quill in position after wrapping the thread around the spindle. As the full quill is removed, the yarn end is carried back on the quill and made fast with one or two slip knots. This method assists the weaver and prevents ravelling, and wastage of costly yarn.

When necessary to tie knots, it is often a good plan to guide each knot to the top of the previous filling wound on the quill, as, in many cases, a knot allowed to wind on the quill, and to become covered with the material, will break the filling while weaving and may also break out warp ends. It is a well-known fact that a carefully-arranged and well-conducted quilling room will pay for itself in the long run.

Quilling and Filling Supply Department

In any mill where plain fabrics are manufactured in large quantities, the quilling and filling department should give very little trouble, providing it is manned with reliable and experienced operatives, but in mills where a variety of fancy fabrics are manufactured, calling for the use of all sizes of material and many colors, often in small quantities, the proper control of the quilling department requires experience, skill, and managerial capacity.

It would be difficult to select and recommend any one system of management for this department, but, in adopting any system,

one of the first things necessary is to secure the services of an experienced, reliable and intelligent department head. Such a man must have patience and exhaustive knowledge of the various yarns, sizes, and colors, and of the weaving uses they are to be put to.

It is very necessary for the department head, in turn, to secure intelligent winder, doubler and quiller operatives, and board fillers. If the mill management can afford to employ a man who is familiar with repairing machinery, and who can, at the same time, keep the department in order, such a course is advisable.

There should be supplied tables, shelves, and plenty of drawers, properly arranged, with each shelf and drawer numbered, for the convenient storage of yarns to be worked, and a good supply of boxes, baskets, bobbins and quills. Should there be large stocks of various yarns and colors, the system of using different colored bobbins and quills should be adopted. Such a system has proved its value time and again as it not only prevents mistakes, but saves much valuable time. A list covering the different colored bobbins and quills, and stating which kind of material to wind on each color, should be distributed and hung in several convenient places so that it may be consulted when necessary.

Quill Board Fillers

To supply the weavers with filling, boards are provided containing a series of short-length wires or nails, driven upright in the board, upon which the quills are placed heads down. These are generally called quill boards, and are used to hold the filling for weaving purposes.

While the weaver is using and emptying the quills from one board, the board-filler prepares a duplicate board, which remains in the filling department until the original board is returned by the weaver who is given the duplicate board. This operation is repeated until the warp is run out.

The board-filler is given proper orders as the warp is being placed in the loom, and is again notified when only a few yards of the warp are to be finished, which acts as a check and simplifies the work of the filling and emptying of the boards.

The desirable quilling operative possesses such traits as intelligence, reliability and activity, as well as a good memory. Experienced operatives are quite familiar with yarn sizes and colors. This class readily discovers imperfections in yarns and takes pains to remedy such defects before the quills are sent to the weaving room. Too much care cannot be taken in the important matter

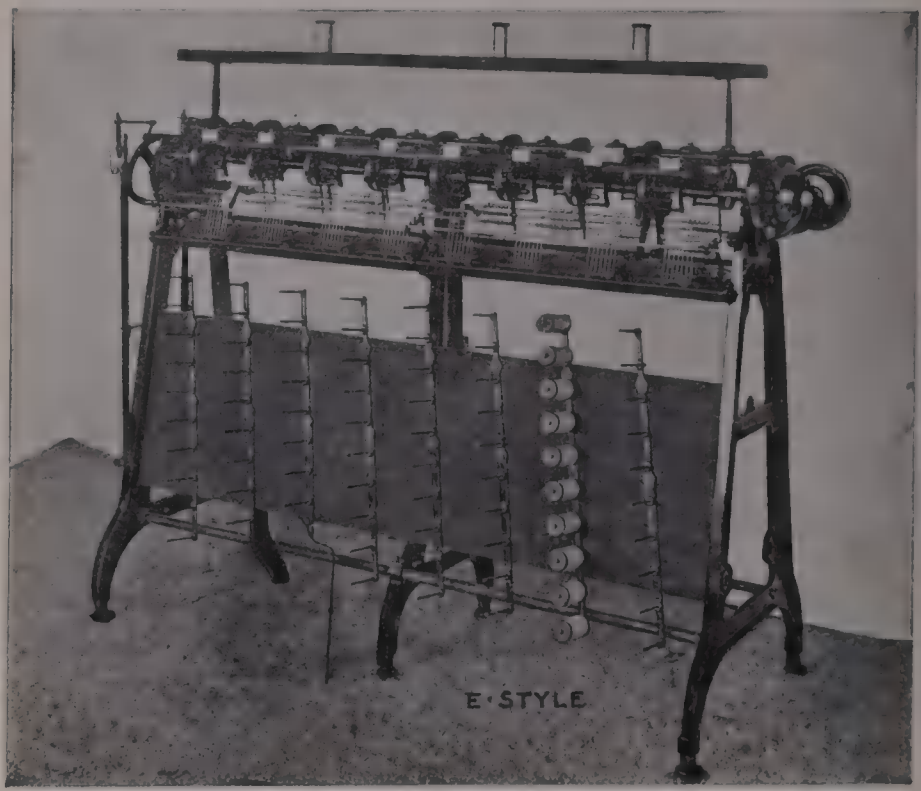


FIG. 17.— Doubling Machine.

of lot numbers, and the reliable employee, under all circumstances, makes it a point to follow and remember the lot number before the delivering of the filling to the weaver at the loom.

Process of Doubling Materials

The doubling machine is similar to the skein-winding machine with the swifts omitted, and with a series of bobbin pins projecting from the frame, directly below each set of spindle bearings. Small

friction levers, with adjustable tensions, rest on the bobbins when necessary. A series of stop motions, with pivoted faller-wires, is provided to control the separate ends, so that any desired number of threads can be collectively wound on the take-up bobbin, at one time. Each thread is so passed through the faller-wires that, if one should break, or run out, its faller-wire would drop and cause the spindle and running bobbin to stop immediately, giving the operative an opportunity to repair the broken end or ends. This operation is termed doubling.

This machine is simple in operation, and is employed in some mills because of its use for rewinding materials from other bobbins previously wound from the skein, and it is very convenient for the doubling up of remnants and odd lots that accumulate in a mill from time to time. It is also useful when filling material is required consisting of two, three, or four or more threads to give a good body in the fabrics, and produce the desired effect in the pattern. The number of spindles that an operative can attend to, keeping them supplied and running, depends largely upon the material, size, and number of ends.

CHAPTER V

MISCELLANEOUS MATTERS

Supply of Good Bobbins Advantageous

A VERY important item for all silk mills to consider is that of having a good supply of the very best bobbins obtainable, as it will pay in the long run. Specially divided boxes, or bins, should also be provided and placed in a convenient place. If colored bobbins are used, each color should be kept separate, clean and in good order. Quills should be cared for in the same manner.

All operatives coming in contact with the bobbins should be instructed to keep them clean, using only sandpaper to clean them, as the use of a knife or scissors for this purpose damages the bobbins. Anyone disregarding these instructions should be heavily fined or made to pay for each bobbin damaged. The use of sandpaper will tend to keep the bobbins smooth. When this treatment is neglected they will always be cut, scratched and rough, causing the material to cling to the bobbins, and making more waste than necessary when they are wound off. This invariably causes smashes while warping.

Another annoying feature appears when remnants and odd lots of accumulated materials must be disposed of to the waste dealer, or when another firm that has been employed to do commission winding or warping in order that the work may be got out more quickly, sends back rough and damaged bobbins, of different sizes and of other ownership, in return for the good, clean bobbins that were sent them.

If irregular bobbins are accepted and thrown in with the regular ones, there is no end of trouble. The operative using them, not knowing they are a trifle too long or too short, starts to wind the yarn on them, and only discovers they are the wrong size when it is too late. The yarn must then be transferred to the regular bobbins, and much time lost. Considerable waste is also caused

by this in many instances. As long as this practice continues, it is advisable for any manufacturer who has commission winding and warping done, or who deals with the waste men, to insist upon having his own bobbins returned to him, or receiving full value for them.

All bobbins used in the mill should be made to correspond with certain standard weights per 100 bobbins, so that the tare can be calculated from the count of the bobbins. Any bobbins that find their way into the mill, which do not correspond with the mill standards, should be immediately and unhesitatingly discarded, no matter how good they may be in other respects, as their use will invite serious and constantly recurring errors in calculating the weight of wound silk.

Employing Help

Good judgment and experience are required in engaging employees and putting them at the work for which they are best fitted, and in managing them while at work. The first thing to be considered in an applicant is his appearance. If this is favorable, he should be questioned as to his age, former employment, and the reason he left his previous position. He should also write his name and address. In this way, an opinion may be formed, and if it is favorable, the applicant may be put at work, if there is a vacancy; if not, his name and address may be kept for future reference.

There are times when it is necessary to employ beginners. If, by chance, the learner has a friend in the same department in which he is placed, it will be an advantage for the friend to take charge of him. Otherwise, the foreman may be at a loss, as he expects more or less trouble in finding an experienced operative fitted to take charge of a beginner and show him the work.

Experienced hands are not always willing to teach, especially if they are on piece-work, as they lose more or less time and, consequently, money, while giving instruction unless they are paid in some way for teaching. Those who are working on time, or by the day, are more willing to instruct, as they are receiving pay for the time thus spent.

It is remarkable what a number of mill hands apply for work and claim to be proficient, but, when put to the test, seem to know very little, though they claim to have worked at their trade for a considerable length of time. The operatives themselves are not entirely to blame. The trouble was probably with their instructors, who, very possibly, did not know much more than those they were teaching, lacked experience, or did not care to teach too much. It is very annoying to a foreman to give instructions when his operatives do not know what he means, and there are many important things concerning the work that the employees should know, but do not know.

It is a common thing for mill workers who have had plenty of experience to be unwilling to teach beginners what they know. This is one reason why many so-called experienced operatives really do not know enough to be classed as such, and do not understand what is expected of them by the foreman.

When placing new help, the foreman should watch closely to see how far he can rely upon them. If he finds that they are ambitious and industrious, and that there are certain details that they do not understand, he should see that they are instructed, in order that they may become acquainted with the materials and sizes. Operatives should be interested to know what the materials are used for, and why, and the way in which they are used. It is an advantage for all concerned to know what the work is for and how to treat it. A foreman will soon learn that he can depend upon his help more and save himself considerable annoyance if this policy is followed.

Printed forms of rules and instructions are very valuable in these departments. Many times we find operatives who, when they begin to work in the mill, are satisfactory for the time being, but, when they become better acquainted, are familiar and boisterous, and often wish to do things their own way. They are under the impression that they know all about the work, and that no one else knows anything. Under pretense of being everyone's friends, they find out all they can, and then tell all they have heard and more, and do many things to cause trouble among the employees.

It is very easy to talk among a number of operatives, and

carry tales about individuals, imagining it is doing no harm, but it is usually a dangerous practice, as things are repeated in a very different way. It is always better to be careful about talking to fellow workers, as a man never can tell who his friend is.

If, by any chance, such a tale-bearing person gains employment, every means should be tried to get rid of him, as there will never be either peace or success while he is about. Under no circumstances should he be kept, as he is likely to hinder and keep away good help by his misconduct. Employees that gossip and talk behind one's back, do things they should not, and are not willing to obey rules and instructions, cannot be relied upon and are not loyal to their employer.

It is not always advisable to dismiss undesirable operatives too soon, nor for every small thing that is done, however provoking they may be, especially in a locality where trained and skilled help is none too plentiful. Hasty judgments should be avoided as much as possible. Patience and even temper are more to be cultivated. Operatives should be encouraged to learn and take an interest in their work. If a foreman is fair and upright in his treatment of those under him, he will find that anyone of common sense will pay him back in kind. It is always better to have the good will of the operatives than their ill will. During an experience of twenty-five years as a foreman, I secured the very best service from those under me by using them well, respecting their feelings, treating them fairly and impartially, with no favoritism whatever, giving the orders for the work to be done properly and not in a dictatorial manner, making them understand that we must all work for the interests of the owners, and that, in order to do this best, it was necessary for them to do exactly as they were told. When obliged to reprimand them for bad work, I explained to them the loss that the owners sustained, as a result of their neglect or carelessness. If that was of no avail, I had a little confidential talk with them to make them understand and make good.

To get the best service from his operatives, it is necessary for a foreman to study their dispositions and act accordingly. With some a slight reprimand is sufficient; with others, talking has no effect whatever. It goes in one ear and out of the other. Then it is necessary to use as few words as possible, but have it dis-

tinctly understood that you mean exactly what you say, and in most cases this will end the trouble. In this way, a foreman can maintain good discipline and have the respect and good will of all under him. The most efficient service will be obtained and the best interests of his employers conserved. The best results can only be obtained when manager, superintenent, foreman and operatives work harmoniously together.

Dismissing Help Temporarily

There are very few textile mills able to keep all their help and machinery working all the year around, a fact that is due in large part to the demand for changes of styles for the different seasons, causing busy and slack times. When the slack times come, and it is necessary to work shorter hours and with less help, it is customary to keep the oldest employees, who have given satisfaction and should have the preference, employed as long as possible. It is not a pleasant duty to lay off help at such times, but it is only fair and right for a foreman to decide whom to dismiss, without showing any partiality at any time.

Complaints

If, at any time, it is necessary to complain or receive complaints about the operatives for poor workmanship, mistakes or misconduct, the foreman should investigate and locate the real cause of the trouble in order to be positive he knows how to act and deal with it. No matter who it is, he should have a fair chance to explain how and why it happened; then the foreman can act according to the nature of the complaint. He should be fair, use good judgment and common sense, and treat the case as it deserves. If it is a mistake and is shown to have been made through a misunderstanding, he must make the best of it. But, if poor workmanship and mistakes prove to be due to the carelessness or willfulness of someone, the offender should be made to pay the consequences. If there are any cases of disturbances, misconduct, or bad behavior among the operatives, do not hesitate to dismiss the guilty ones; otherwise, a well-organized department will be ruined.

It does no harm to complain, and in many cases it is a good thing, especially when it is a little difficult to locate the cause and know whom to censure for the defect. If there is any reason to find fault about any poor workmanship, do it in the right manner. A foreman can usually determine by the excuse given whether the operative is at fault or not. Without doubt, there are times when a man finds out things he had never dreamed of. Operatives are often kept from doing good work by the poor workmanship of the previous operative. Winder, warper and quiller operatives are generally more or less reluctant to find fault with the work of previous operations, even when they know they should report the defects that are the result of another's carelessness, and that hinder them. They know it creates more or less ill feeling among themselves, which often ends in their being abusive. With all these troubles it is well to give good warning to all operatives to be more careful, and it is as well for them to know that all defects are not so easily overlooked; otherwise, they would not know but the workmanship was perfect and in no need of criticism for defects.

Waste of Materials

There must always be a reasonable allowance made for the waste of material in winding, warping and quilling, but if there is no proper system installed to keep in touch with it, more waste will accumulate than the allowance calls for. To avoid this is a difficult problem, as there are many ways in which it may occur. Sometimes it is due to shiftless and careless operatives, and is more frequent among piece-workers, who are anxious to do all the work they can and do not take the time and trouble to be as particular and exact as time or day workers would be. There is much material torn, cut or destroyed and made into waste that could be saved with a little patience. Some operatives are very careless and free about the making of waste, as they do not realize the value of the material they are working with. Then, again, the materials are often damaged or spoiled in the previous operation, which causes waste to accumulate and which cannot be avoided by the best operatives.

Some manufacturers have a system of keeping account of the

waste by re-weighing the finished work of warper, winder and quiller, thus ascertaining whether more waste has been made than is necessary and allowed. The operative is called to account for this and has to bear the consequences, usually a fine or dismissal.

The accumulation of too much waste is a difficult matter to overcome, and it is not always advisable to be too strict regarding the amount made, as it is well known that some operatives, from fear of being fined or dismissed for excess waste, will take or hide some of it.

To overcome this as much as possible, the man in charge should adopt some system of warning the operatives to be careful, and, by watching and collecting the waste every two or three days, ascertain which ones are at fault.

Bags should be attached to the machines for this purpose, and operatives should be instructed to put all waste in these bags, and not on the floor to be swept out. In this way, there will be some information about how much waste is made and complaint may be made to the operative if too much is found. Each one should be made to account for it, and if the excess is found to be due to carelessness, the one at fault should be warned to check it or bear the consequences. If it is the result of worn machinery, this should be attended to as quickly as possible, otherwise waste will be bound to accumulate.

Light

Poor light is one of the greatest hindrances to success in all processes of textile manufacturing. The best daylight, or artificial light, obtainable must be furnished in order to obtain good results and production from a mill and all its departments. Light from overhead, through a sawtooth roof facing the north, has been tried and is considered the best light for all mill purposes. It can be relied upon and is more evenly distributed, in addition to which the machinery can be placed in an advantageous position to get the full benefit of the light. With side windows, the machinery must be so placed as to take advantage of the windows.

More or less artificial light must be used in all mills and there are many kinds from which to choose The latest improved elec-

tric light is none too good, and the best obtainable should be installed, especially for silk manufacturing. Experience has demonstrated that it is impossible to turn out as perfect work with artificial light as it is with good clear daylight. The great difference is easily noticed in the change from the summer to the winter season, from long to short days, when all mills must use artificial light a few hours each day, and, many times, all day.

On account of the difficult and exacting work that there is to be done in silk mills, every operative should wear a dark green eye shade to assist and protect the eyes. No matter how young and strong the eyesight is, it will do no harm to wear a shade, as in time to come it will prove to have saved the eyes.

It must be borne in mind by using a shade, an object can always be seen more distinctly, and that one can accomplish better work on a bright day than is the case on dark days when artificial light is necessary. Daylight is the proper light in which to match colors and shades, and the matching of colors in strong sunlight, or artificial light, should not be attempted, as both are unreliable and deceiving. In matching colored skein materials the best results can be obtained on a good, clear day, with light from the north side. The skeins should be properly straightened and smoothed out, then hung up close together, and moved in different ways to get the same effect. If there are any differences in the shade it can be easily seen, and when they are even, one may be satisfied that they are properly matched.

To match colored yarns wound on bobbins is more difficult, as the irregular tension from winding will cause the silk to appear to the eye to be of an uneven or different shade. To overcome this somewhat, turn the bobbins or quills around in different ways toward the light, which will cause them to appear in other shades, but it is better to unravel some yarn from the bobbin or quill and match the two together to get the desired effect.

To Regulate Wages

It would be difficult to advocate the use of a system to regulate the wages, as circumstances vary in all mills, and every manufacturer has his own opinion as to what is the best way to pay

wages. For that reason, some pay by the day, others by piece-work. In some manufacturing, the work is very plain, simple and uniform, therefore, it can easily be arranged to pay one price for all work and materials, or to pay by the day.

The work of other manufacturers is very irregular and complicated, and, therefore, piece-work wages must be arranged to suit the work, which varies according to the different grades or sizes of yarns to be wound, warped or quilled.

Piece-work rates for winding are usually fixed by the skein, hank, or weight. For quilling, the weighing system is the surest, most convenient and fairest method. For warping, the rates are usually per hundred ends for a hundred yards or meters.

When large dye lots are used from which a number of warps can be made with a full set of bobbins on the warp creel, a lower rate can be fixed upon than is usual for one warp and small dye lots.

Mills that manufacture all plain goods, and only one kind of fabric, and which are in a locality where there is competent and reliable help, can easily arrange and establish a schedule of day wages that will be satisfactory and fair to employer and employee, by planning a system whereby the one in charge knows that each person is kept busy and produces a good day's work and earns his pay. It is necessary to hold one person responsible for the keeping of the weighing records and the giving out of work to the operatives, as it is a rare thing to have employees that work alike and turn out the same amount of work, although they all have the same kind of work and opportunities. Day workers, as a rule, require more watching to see that they do a day's work than piece-workers. They generally do so much and no more, and are more apt to take their time to do the work. At the same time, they keep things in order and usually do not destroy materials or make more waste than allowed. But they should do exactly as ordered. They are not so willing and ambitious to produce the quantity of work that they would be if on piece-work.

With piece-work, it is more difficult to establish a fair and satisfactory price for either employers or employees, as circumstances vary so greatly, and the rate depends largely upon what is being manufactured. A method to establish piece-work prices is usually

based upon the rate for day work. For example, take an average of the amount of work a few good day workers will turn out in two or three days; from this amount, the piece-work prices are determined, after a fair and suitable percentage is deducted from it. Piece-work inspires more ambition to hurry and earn as much as possible, consequently a greater production is derived therefrom. But piece-workers are more apt to be careless with their work and need constant watching to prevent them from making more waste than is allowed. They are also usually not so particular

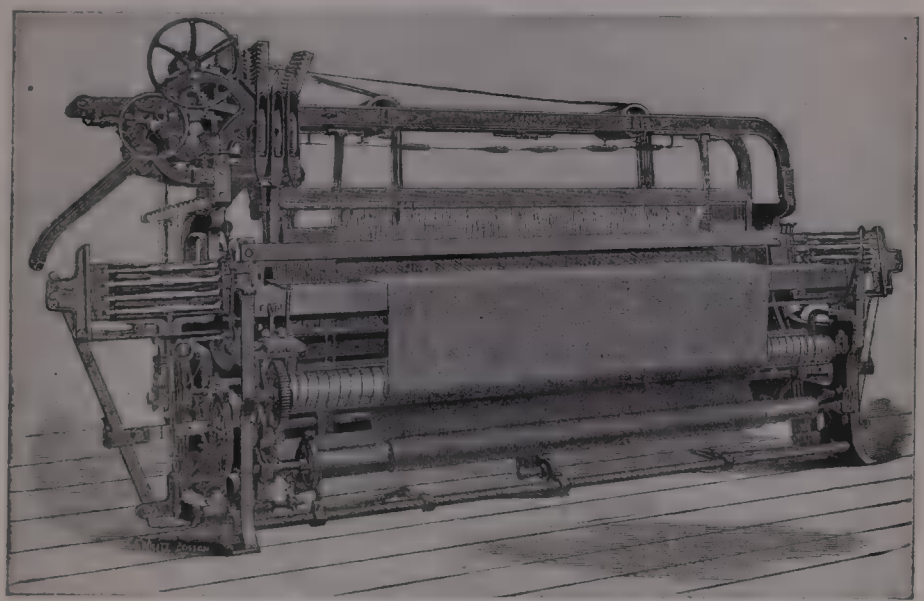


FIG. 18.—Heavy Fancy Shaft. Harness Loom.

concerning the cleanliness and order of their work, and allow waste to accumulate on the floor and leave it on the bobbins and quills.

Arranging Machinery

Satisfactory machinery layouts are not obtained without considerable study. Assuming that the amount of machinery to be used is known, there are many other details that affect the arrangement. The entire equipment should be decided upon, including tables, shelves, closets, drawers, racks, partitions, etc.,

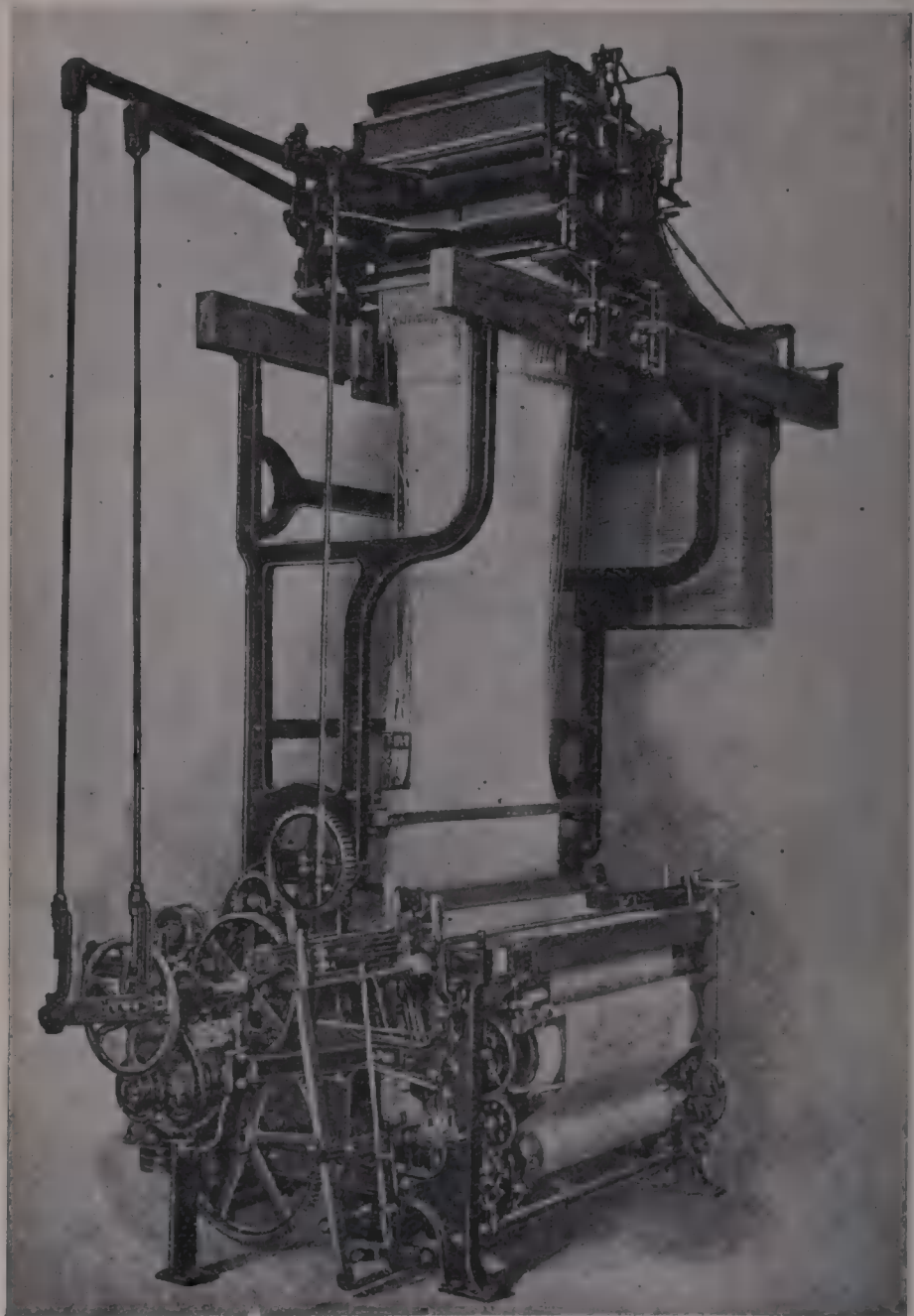


Fig. 19.—Jacquard Silk Loom with Motor Drive.

before the machinery is placed. Then a plan for the whole room may be made.

Plan for Machinery Floor Space

The following has proved to be an ideal method for deciding the simplest and best way of placing machinery, tables and shelves on the floor space.

Take a sheet of paper to represent the floor space, and make a scale of a quarter or half inch to a foot. Cut a piece of cardboard

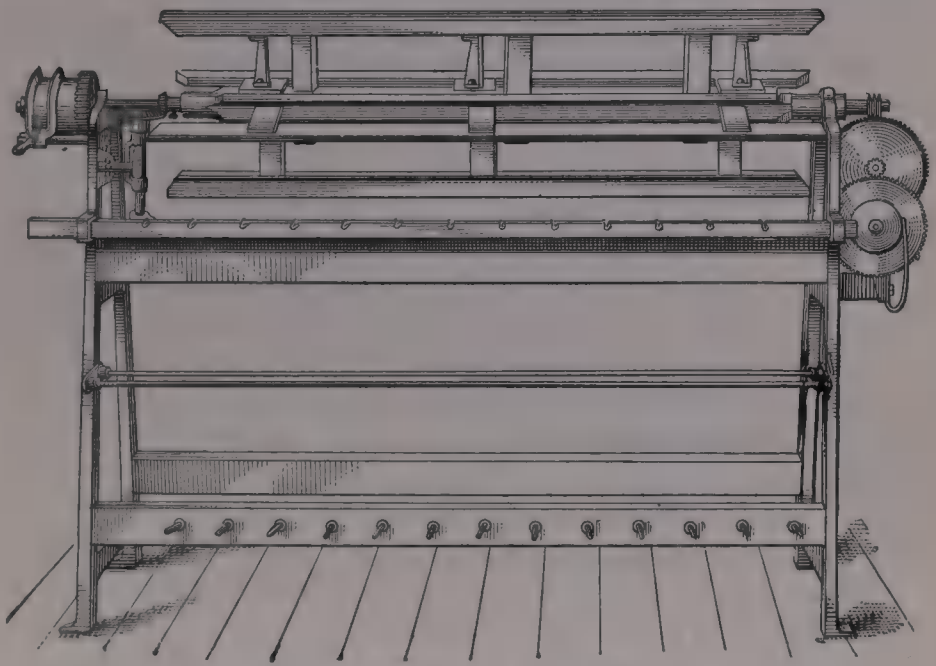


FIG. 20.—Skein Reel, with Single Fly.

for each piece of machinery, table and shelf to be placed, and measure each. Thus, the pieces of cardboard represent the machinery and can be placed upon the paper representing the floor, to the best advantage as regards space pulleys, shafting and light. By doing this, everything is planned on the paper before the machinery is actually placed, thereby securing the best position for each piece. As there are many different kinds of machinery, requiring various amounts of floor space, it is difficult to place

winding, warping or quilling machines in such a way as not to waste floor space and yet have sufficient room for the use of aisles, etc. Placing machinery on a floor before trying a plan like this, may turn out to be wrong, and a costly mistake.

Repairs

Some machinery repairs should be made in the mill, while others should be made outside. Just where should the line be drawn? The answer to this depends upon the size of the mill and whether there is a machine shop near. Small mills usually have a very limited supply of machinery equipment and tools, and find it advisable to have nearly all repair work done outside. The mills that are neither large nor small are those that most frequently waste time and money by sending repair work out when they could probably do it as well themselves. Men in their employ could do the work as satisfactorily and quickly as men in the machine shop if they had the necessary equipment, and, by having the work done in the mill, a profit would be saved that would otherwise go outside. The ability to repair machinery in the mill's own shop often saves valuable time. Idle machinery may interfere with the mill's production, and, if time is taken to replace the broken parts by sending to the machinery makers, several days may elapse before things can be running in the normal way again. Often, the broken parts can be repaired at the mill as well, and little time will be lost on account of the accident. To be sure, new parts may be needed, and the repairs made will be only a makeshift, but, even in this case, it may mean a saving of considerable trouble and many dollars. There are many reasons why the mechanical end of a textile mill should be in charge of a reliable, all-around man, who is well paid and who understands engineering. The importance of making repairs quickly, properly, and economically, is a strong argument in favor of this arrangement.

Some inexperienced mill hands will repair machinery in a slipshod manner, for the time being, by tying the broken parts with cord and ropes, instead of using the proper appliances. This is not good mechanics and often proves disastrous. It is better to repair the machine in the right way, if possible; if not, leave it until the work can be done properly.

All machinery, gear wheels, pulleys, and belts, that are dangerous, should be covered to avoid accidents. No passageways should be obstructed. All female operatives should be compelled to wear a suitable head covering, like a gauze or net cap, to keep the hair from flying about and catching on belts or in machinery.

Supplies Needed

It is very important, and pays in the end, to have a good supply of all articles that are needed in the departments. The list includes belt lacings or hooks, bobbins, quills, edge bobbins, beaming, tissue and wrapping paper, cord, banding, swift spokes for repairing, swift braces, wooden and iron winder spindles, waste bags, cloth coverings, warping reeds, cut-mark paints, chalk, emery cloth, sand-paper, waste for cleaning, brushes, brooms, soap, towels, machine oil, belt grease, oiling cans, benzine, mill boxes and baskets, scales, scissors, reed hooks, measuring rulers, pins, carpet tacks, porcelain guides, shellac, glass reeds, wrenches, hammers, screw-drivers, pulleys, belt punches, tension weights, writing paper, etc.

A supply of all tools that the operatives require should be kept in stock and furnished them at cost.

Tracing Oil Spots

Sometimes oil is found dropping from the machines and spreading on the materials, but it is very hard to locate the place from which it comes. If there is any suspicion of the source, lay or hang a piece of paper on the machine at the place where the oil is believed to drop, and, if there is any, it can readily be seen on the paper.

Luncheon

It is a poor policy to allow the operatives to have luncheon in working hours, as they gather together and take advantage of the opportunity to visit and talk among themselves. In this way, they lose considerable time, and seem to forget that the power is on and the machinery running for nothing. If it is necessary for anyone to eat during working hours, he can lunch and, at the same

time, keep his work and machine going, provided he is very careful not to soil the work with his hands.

Sweeping

All operatives should be instructed to be careful when sweeping the floor. Everything that has any value should be picked up and taken care of, especially such articles as bobbins, quills, screws, nuts, washers, small weights and parts of machinery, also waste material.

Table of Bobbin Weights

The following table of bobbin weights has often proved to be serviceable and convenient when it was necessary to use it for weighing wound materials. For example, mark the weight of each number of bobbins and quills, from one to one hundred, on a good-sized sheet of paper in the way prescribed here for a given number of bobbins and quills:

No. of Bobbins.	Lbs.	Oz.	Drs.	No. of Bobbins.	Lbs.	Oz.	Drs.
1	0	2	4	100	14	2	5
2	0	4	8	200	28	4	10
3	0	6	12	300	42	6	12
4	0	9	1	400	56	9	4
5	0	11	5	500	70	11	8
And so on until 100 is reached.				600	84	13	4
				700	99	0	3
				800	113	2	8
				900	127	4	13
				1000	141	7	0

To make this table of weights may seem difficult. It will certainly take time to do it, but the convenience and time saved are worth the trouble and when used it will prove its value many times. Often, when it is found necessary in these departments to take the weight of materials wound on bobbins and quills, this method will be found to be convenient, simple, quick and reliable, especially when taking inventory. When large quantities of bobbins and quills are to be weighed, a special box or basket should be used for weighing only, and it would be better if the box weighed

about 5 or 10 pounds, as such a number is easier to deduct from the gross weight, thus avoiding trouble and mistakes.

Book Systems

As circumstances and conditions vary so much, it would hardly be advisable to advocate any definite system for booking and charging the stock accounts of materials, or filling out the warp tickets, and recording the work, in general, of these departments. No matter what the system is supposed to be, it must be the method best suited to the management and circumstances.

It may be advisable to use a loose-leaf or card system. This can be recommended as being the most reliable and systematic method of keeping records and accounts of stock and materials in connection with the warp-order tickets and book.

Yard and Meter Measure

Metric measures are frequently used with the yard measure in silk warping, some mills having only the Swiss warping machines, while others have only the horizontal, and still others have both.

Usually, the Swiss machine runs on the metric system, and the horizontal on the yard measure. Operatives are often found who do not understand the difference between yards and meters. This should be fully explained to them. The meter is about $9\frac{3}{8}$ per cent longer than the yard, and (as being very convenient) ten meters is counted as equalling 11 yards, and 100 meters as 110 yards, this being an assumed difference of 10 per cent, which, of course, is not accurate.

Dining, Dressing, and Emergency Rooms

A factory employing both sexes, and having space enough, should furnish a room, or wardrobes, for the employees' clothing, and a dining room. There should also be a convenient and comfortable room, with a medicine chest, to be used in case of accidents or sickness, so that suffering employees may be made comfortable and be properly treated. If there is no such room, an operative who becomes sick is usually stretched on the floor until

sufficiently revived to go home. This generally causes considerable excitement and disturbance among the other operatives, and a consequent unnecessary loss of time.

Changing One's Position

A foreman changing his place in order to obtain a better position, often finds conditions in his new mill very different from those he has left. He may have a good record for experience, and may have understood his business thoroughly in the place he has left, but he will feel very strange in his new surroundings. He may wish to make a number of changes, but if he attempts too much at once he will find himself in a great deal of trouble. He must work slowly and become acquainted with his new environment, as he will, no doubt, wonder at the way things are managed. Changing things slowly in order to make them fit his ideas will naturally benefit him as well as his employer. No one has had experience enough to know all there is to know about textile manufacturing, but the more a man goes from mill to mill, the more he will learn.

CHAPTER VI

REMINDERS, DUTIES AND RULES

A Few Reminders for Inventory

ALL mills take inventory at least once a year and everyone has his own opinion about the proper way to do it. Two inventories are seldom taken alike; in some mills it is not even taken in the same way two years in succession, owing, no doubt, to the changes that take place, bringing different ideas to those in charge of the mill and of its different departments.

Stock taking does not occur often enough in mills to enable anyone to decide when it is correctly done. It is always necessary to take stock quickly and accurately, and, should the one in charge have suitable assistance, he should see that all are properly instructed, or each will have a method of his own, which may prove disastrous.

The importance of counting, weighing and listing the materials at inventory cannot be over-estimated. Care should be taken to avoid mistakes when counting the bobbins and quills, and also to count by fives, otherwise mistakes are apt to occur. When weighing wound materials in boxes or baskets, the receptacles should be of even weight, say 3, 5, or 10 pounds, and the weight should be plainly marked on the box or basket, so that the same weight is used at all times.

For listing and booking the weighed materials, a fair sized loose-leaf book is best, properly ruled and headed for the different sizes of materials. The loose-leaf book will be found to be more convenient and safe than sheets and slips of paper, as they are apt to get mislaid.

The following are a few reminders that are useful when inventory time is approaching, and which should be kept on file for reference, in order to have the same system each time when taking stock.

1. Books and sheets should be ruled and headed for the different materials.

2. Typewritten slips should be prepared for entry of weights and number of wound bobbins and quills.

3. Lot tickets should be in plain sight on all material in shelves boxes, baskets or drawers.

4. All assistants needed should be engaged a few days before the time.

5. All assistants should be instructed to count bobbins and quills by fives, instead of any way it happens. This way is easier, quicker and more reliable, and avoids mistakes.

6. Assistants should be instructed how to mark the number of bobbins or quills on the slips.

7. They should also be shown how to use the scales and how to mark the weights when weighing the different materials.

Important Duties of a Foreman

1. He should be present at least five minutes before starting time, both morning and noon, and should be the last to leave at stopping time.

2. He should see to the lighting, heating and ventilating of the department.

3. He should start the power, and see that all machinery is running properly.

4. He should have all operatives on time in their proper places, ready to begin, and keep them supplied with work.

5. He should see that the floors and windows are properly cleaned. There should be a general cleaning of machinery once a week, and it should be oiled at least twice a week.

6. He should allow no bobbins, quills, or waste on the floor.

7. He should insist that all operatives maintain order and obey all rules and instructions; also that they give due attention to their work in all its details, in order to turn out a perfect product.

8. He should have all materials properly taken care of and put in the right places.

9. He should see that all orders from other departments are promptly attended to.

10. He should keep a record of the time of the operatives and an account of the materials.

Rules and Regulations

Printed rules and instructions, similar to those following, will prove to be of great value in these branches of work in every textile mill. Every employee should be supplied with a copy of these rules, that he may become familiar with the part that concerns himself and his work. This will greatly assist him in understanding and at the same time will instruct him as to what is the quickest and easiest way of doing the work. Then, there will be no excuse for the operative not to follow instructions and obey rules. In this way, both the man in charge and his employer will know that the operatives have the required information about their work.

In connection with the rules, a notice, printed in large type, should be placed where it can be readily seen, and should read somewhat as follows:

"All employees are required to read these instructions and follow the rules laid down.

(Signed).....

The Rules

1. All winder, warper and quiller operatives will receive material, ticket and lot number at their machines, with instructions how to treat the same. Tickets must be examined in order to avoid mixing lots and making other mistakes. Tickets should not be mutilated nor destroyed, but always kept in plain sight. Winder operatives should use only wooden-pulley spindles for winding silk and fine yarns, and iron ones for coarse yarns. Only clean bobbins should be used and they should not be cut with a knife nor scissors, as these will damage the bobbins. They should be cleaned with sandpaper, in order to clean them and keep them smooth. The tension weights should always be even, and they should be changed according to the different sizes of the yarn, so that the yarn is not wound too hard nor too soft. Every bobbin should have strict attention, so that all will be even and uniform, with no waste nor lapped ends on them. Winder operatives, when

winding small lots of yarn, should always find out the number of bobbins the lot is to be wound upon. Scissors should be used to cut off the ends, after making good knots. After tying all knots, the ends must not be cut off shorter than $\frac{1}{8}$ inch and not longer than $\frac{1}{4}$ inch. Special cross knots must be made on all mercerized warp cotton, extra care being taken when winding white to turn in good clean work. No waste, spindles nor bobbins should be allowed to lie on the floor.

2. All imperfections in materials should be reported to the foremen when winding, for example, dirt, unevenness, lumpiness, ends, split ends, weak or shady colors. No skeins should be cut off nor destroyed. All waste should be saved and put in the bags kept in place for that purpose.

3. A great deal of unnecessary trouble and damage is caused to warpers', doublers', quillers' and weavers' work, as well as to the woven cloth, by letting loose ends, threads, and waste run on the bobbins and quills. This generally comes from the carelessness of the winder operatives in allowing waste and cut-off ends to accumulate on their clothing. Operatives should be careful about this unnecessary evil, and keep their clothing free from waste. If they do this, it cannot catch and run in on the bobbins and quills when winding.

4. All warper operatives should read over the warp order and the warp ticket carefully before tying up the ends on the creel, to see that the material, color, number and lot number to be used to make the warp correspond with the warp ticket. When two lots of the same shade and material are used in a warp, both lots should be examined, and, if any unevenness in color is noticed in the first section, it should be reported.

5. No waste nor dirt should be allowed on the creel. Some other warper operative should always count the number of ends and bobbins before starting to run them on the reel, in order to see whether the ends are to run in a single or double cross-reed.

6. Before starting a warp, Swiss-warper operatives should always call the foreman's attention to the elevation irons on the reel, to see if they are set right for the warp that is to be made, and observe if the measuring dial is set right for the length of the warp, corresponding with the warp ticket. Some other warper

operative should always see that the cut marks, made with colored string, painted and covered with paper, are put on a few ends of the first section or band in exactly the right place.

7. All sections or bands, when started on white warps, should be kept moving to avoid dusty and soiled sections, and none should be allowed to stand unfinished after the power is off. All warps should be covered properly before they are left at noon and night. All work should be made good and clean, with good knots and special cross knots on all mercerized cotton. All empty bobbins should be cleaned, using only sandpaper to keep them smooth and free from waste.

8. To verify the width, the first section, or band, should always be measured after reeding, before starting to run in on the reel, and from this should be figured out the required width for the warp. The width of the warp should always be measured when finished.

9. On all partly finished warps, if some of the ends have been cut down, the number of finished ends should be marked on the back of the warp ticket before leaving at noon or night. This is absolutely necessary in order to avoid misunderstanding if an operative is absent from work.

10. The condition of all warp materials should be reported to the foreman. This includes bad winding, dirt, lumps, split ends, uneven ends, weak or shady colors. No material should be taken from the winder operatives, nor should two or more lots be mixed in a warp, without proper instructions. The lot tickets should always be kept in plain sight and neither mutilated nor destroyed.

11. Doubler operatives should pay strict attention to their work and follow instructions, seeing that all bobbins are running evenly and uniformly, and with the necessary tension to make good, clean work. They should report all imperfections in work and material. Empty bobbins should be cleaned, using only sandpaper to keep them smooth and free from waste.

12. Quiller operatives should also pay strict attention to their work and follow instructions. Special care should be taken when starting up a quill to get the end in firmly, in order to avoid running over into the groove of the quill. All the tension weights should be even, and they should be changed as required for the

different sizes of material, so that the quills will be neither too hard nor too soft. When white or light colors are being used, special attention should be paid to keeping the material clean. Scissors should be used to cut off the ends when knots are made. The knot should be run on the outside of the quill, so that the end will run off freely from the shuttle when it is weaving in the loom. When using flyers, the end that runs off the spool or bobbin and passes through the flyer guide should turn from right to left, so as to make the required twist in the yarn when it is used in weaving. Empty bobbins should be cleaned, using only the sandpaper, as usual. Quiller operatives should clean their machines every day before starting work at 7 A.M. and 1 P.M.

13. Weavers should be requested to notify the Quilling and Filling Department when receiving a board of filling whether there is enough to finish the cut, and when bringing the board to the Quilling and Filling Department, after the piece is finished, should wait until the board is emptied. The board should be returned to the loom.

14. Board-fillers should see that the weavers are supplied with the filling required by their loom order, and should be very exact in giving out the right material, so that the lot numbers, colors and sizes correspond with the order ticket. The lot number is the surest guide to accuracy and must never be overlooked, as the slightest error on the board-filler's part may cause many yards of fabric to be woven wrong, involving great loss. Any misconduct on the part of the weavers should be reported, also any imperfect work, or unevenness of shade. Instructions should be followed as given. The department should be kept clean and in good order. No waste should be allowed to hang on the fixtures, and quills and waste should be kept off the floor.

15. All employees should be in their places promptly at 7 A.M. and 1 P.M. and no time should be wasted in singing, unnecessary talking or stopping to eat lunch, until the whistle blows at 12 and 6 o'clcok. Those who remain in the mill during the noon hour should maintain order and stay in their own departments. Hats and coats should be kept in the dressing room. Anyone leaving the mill during working hours should have a pass to be furnished by the foreman. Anyone who is absent from work

through illness, or any other cause, should notify the foreman at once, or run the risk of losing his or her position. No one can receive pay for unfinished piece work. When an employee is unable to receive his pay personally, and requests another to receive it for him, he should give his representative a written order, signed by himself. All injuries caused by accidents at work should be reported at once. Employees leaving their work or position without giving three days' notice will risk the forfeiture of their pay.

16. The power will stop every Saturday one-quarter of an hour before the whistle blows at 12 o'clock, to allow for cleaning the machinery. In order to avoid accidents, no machinery may be cleaned while running. Employees will not receive their pay until their places and machinery are thoroughly cleaned, and have been inspected and passed by the foreman. All machinery should be oiled every Monday and Thursday morning.

17. All employees should give strict attention to their work, follow instructions, and obey the above rules. Those making mistakes or injuring the work through carelessness and neglect will be subject to a fine."

CHAPTER VII

DEFECTS AND THEIR CAUSES

Defective Fabrics

VOLUMES could be written upon the subject of imperfect fabrics, and the defects that arise from the different processes before and during weaving. In touching upon this subject, the intention is to advise rather than to criticise, the object being to impress upon the reader's mind the fact that none of the processes are immune from defects caused by poor workmanship. There is also much that can be said and done about yarns before they are subjected to the processes of winding, warping and quilling. Good weaving depends greatly upon the workmanship of every previous process. From the beginning of the material going into the yarn, through the extensive operations before it reaches the loom, every process has its bearing on the quality of the woven fabric.

It is the aim of every mill owner to produce perfect fabrics, as far as possible, but this cannot always be done. One of the greatest problems of the textile industry is the prevention and overcoming of defects. It is admitted by all in the field that no one person possesses sufficient information and experience to recognize and solve each and every problem that arises in manufacturing. The number of ways in which yarns and warps may be injured by mechanical action during the different stages of manufacture, are so great that it would be impossible for any one person to describe all the causes of imperfections in all kinds of fabrics. There are often defects in the various processes that the yarn passes through that cannot be discovered without thorough tests, chemical and physical, and the use of the microscope. Yet many of these defects can be readily seen when woven into some of the fine, plain fabrics.

It is impossible to make a good fabric from a poor grade of yarn, although a good deal of it is used, and for some classes of goods it does very well. All mills produce some imperfect fabrics and a large part is due to mistakes in the selection of material, faulty yarn structure, inefficient machinery, poor workmanship, carelessness on the part of the working staff, and last, but not least, to theoretical instead of practical managers.

What is lacking many times is good judgment, and the quality of mind that enables one to face difficulties and overcome them in the best possible way. Even with experience in detecting defects in fabrics at every stage in their production, there are sometimes apparently insurmountable difficulties. Defects arise from causes so nearly alike that no expert could tell the cause unless he knew in advance where the trouble lay. A defect is, therefore, many times traced to one thing, when it is, in reality, due to something quite different.

Another point to be noted is that it is frequently easy to locate the cause of a defect, but difficult to prevent it or guard against its recurrence. Anyone engaged in the weaving process (or any other, for that matter) should study his work. Although many operatives in this department have some idea of the principles and details of the work, weavers, loom-fixers and others, in general, seem to consider that the loom does the work and that their duty is only to watch it run. But much more is required if good work is to be produced, passed by the examiner, and delivered to the owner in such a condition that he can expect the full price for his goods, and not fear having to sell at a loss.

It may be assumed that the weavers are women, though they are no worse than the men in the matter of carelessness. In either case, there are many details for weavers and loom-fixers to consider. It is the duty of the weaver to study every little point and have every apparently trifling matter corrected before proceeding with the work. In one way or another, the ends from the warp may break down and go wrong, and, consequently, the warp is frequently condemned when there is nothing the matter with it. The fault may be in the setting of the loom, or due to some other cause. The weaver goes on tying the ends up, thereby necessarily marring the warp, blaming it for all the trouble, and weaving a

defective piece of goods that she herself would not buy from a bargain counter at a sale. At the same time, a warp from the same yarn, and same warper, weaving the same pattern, may be going all right on another loom. Observance of the foregoing suggestions will facilitate the remedying of such evils.

An intelligent weaver, if properly directed by the loom-fixer, will soon notice these details and save trouble for both. Few loom-fixers realize their responsibility. It should be the loom-fixer's duty to see that every weaver not only knows her work, but attends to it properly and reports to him the slightest trouble in the working of the loom. He can then correct it immediately.

Every new style of goods coming to the loom should be carefully considered, that the loom-fixer may know exactly how to set the loom so it will weave to the best advantage, and to discover, also, if it should start up badly, what the probable cause is.

The following are some of the numerous evils and damages, though by no means all, that the manufacturer and operatives have to watch for and contend with, found in the different processes of manufacturing fabrics:

Raw Silk and Silk-Throwing Defects

Uneven size, irregular, hard, soft or corkscrew twist, broken fibers, nibs, knots, double ends, waste or improper tension, will cause fine and coarse streaks in both warp and filling.

Other Yarn Spinning Defects

Uneven size, a hard, soft or uneven twist, kinked or looped threads, slubs, lumps, specks, cotton-seed hulls, or hairy yarn will cause imperfect cloth.

Dyeing Defects

Unevenness of snade, dirty or oily spots, hairy yarn, overweighting, imperfect chemical treatment, rough handling, artificial lustring, will all cause defects and damages due to faulty dyeing operations.

Skein and Quill-winding Defects

Very hard- and soft-wound threads in the warp will show streaks lengthwise.

Threads will carry dust, lint, and flying fibers that accumulate around the machinery, into the yarn, and also into light-colored woven fabrics, causing defects.

Soiled and perspiring hands tying knots make dirty spots and streaks that cannot be removed by any known method.

Cracked and worn guides scrape, damage, fray and roughen the threads, causing streaks.

Dyed yarns, too long exposed to the light, will cause uneven and shady streaks.

New and old dye lots of yarn in the skein, or wound bobbins, carelessly handled and mixed, will cause very bad streaks in warp or weft.

Too hard quilling will crack and split fine yarn and produce hairy fabrics.

Too soft quilling will cause the filling to snarl and break, will make uneven places, and cause floats, waste and smashes.

Bobbins or quills, containing light-colored yarn, if not kept clean, will collect dust, oil spots, water spots, etc., that will make marks in the cloth.

Cotton, wool, silk or other yarns, wound in close proximity to each other, will often absorb lint and other flying particles, and show specks in the goods.

Warping Defects

Worn, damaged, rusty or soiled reeds will cut, scratch and fray the yarn and make dirty streaks and marks.

The improper mixing of new and old lots will make streaky warps.

Inaccuracy in spacing sections will cause warp streaks from opened and lapped sections, commonly called section marks.

Slack beaming will cause rough appearing fabrics.

Bobbins wound too hard by one winder and too soft by another, and not properly mixed on the creel, are very apt to show in some fabrics.

Dust settling on unfinished sections will show dirty stripes on light colors.

Threads tied too tightly or too loosely will show streaks.

Too many smashes tied in a small space will show a rough place from so many knots.

Soiled beaming paper will spot the warp.

Loom and Weaving Defects

The twisting and sticking of yarns at the cross rods will cause light streaks and floats.

Extreme cold and damp in the weaving room will effect various parts of the loom machinery and harness, and it is out of the question to work in such an atmosphere, and weave perfect fabrics.

A damaged reed with rough, rusty, bent and worn blades will cause streaky, dirty and imperfect fabrics.

Too much, or improper, oiling of machinery will cause dirty oil spots and streaks.

Dirt, fiber and lint from the harness, or Jacquard machine, will cause dirty spots and streaks.

Stopping over night is apt to make reed and harness marks in white and light fabrics, owing to dust settling, and the strain of the shed left open in the harness.

Any end wrongly drawn in the harness or crossed in the reed will cause streaks.

Many ends broken, from various causes (commonly called smashes), and pieced out with many knots will cause bad places.

Cut heddle eyes in the harness will fray and split the warp ends and make fine streaks.

The loom working irregularly or out of time will produce imperfect fabric.

The filling-stop motion being out of order will cause streaky marks from broken picks of filling.

If the take-up motion does not work right, it will produce thick and thin places, broken or miss-picks in the weft will make empty streaks crosswise, and two picks in a shed will make a heavy streak across the fabric.

Uneven doubling in filling yarns, uneven shuttle tension, or too tight selvages will produce cockled effects.

Dirty shuttles will mark the fabric crosswise.

Skipped and crossed ends in the harness will cause thin streaks in the fabric lengthwise.

Trifling mistakes in designing and card-cutting, and in the harness, cause imperfections, and are sometimes not discovered till many yards are woven.

Too tight, too loose, or uneven, tension weights, on weaves that require two or more beams for the warp, will produce an uneven and rough appearing fabric.

Joining marks are caused by an improper setting of the take-up motion after picking out bad spots.

Moistening the fingers, or using rosin or glue to stick rough ends together, will cause dirty places in most goods.

Wax, or other preparations, used to dress or size skein-dyed warps, will ruin many fabrics.

Miscellaneous Defects

The use of the wrong quality or size of yarn in constructing fancies will produce defects, such as thick and thin places, cockling, grinning colors, loose and long floats, specks, streaks, etc.

Poor designing and combining of weaves makes faulty cloth.

Placing a warp on the wrong kind of loom will often develop very mysterious defects.

Lack of knowledge in arranging the proper counts, harness drafts, box chains, picks, etc., will result in an imperfect fabric, provided it can be woven at all.

Uneven, too slow, or too fast, speed in the power will result in defective work.

A loom will weave imperfectly if it does not stand firm and solid.

Poor light allows many defects to occur that might otherwise be detected and prevented.

Old or defective machinery is responsible for many imperfections that would never occur otherwise.

Efficient Mill Administration

In concluding this manual, the author wishes to say that a mill that is correctly organized should be able to account for every

pound of stock in the mill, cloth, waste, etc. A mill failing in this has not reached the highest point as an organization. To attain these conditions all heads of departments should be methodical, systematic men who do nothing by guesswork, but who know and appreciate the value of details. Men of this class will see that the facilities provided are as complete as possible, so that the maximum production may be obtained by the best help.

In preparing this work, the constant endeavor has been to see the matter from the reader's standpoint, and to endeavor to anticipate everything that might cause him trouble.

It is a recognized rule that the help that gives the largest production should invariably give the best. Encouraging this class of help will prove an incentive to the less efficient. On this basis, both quantity and quality of production are more easily obtained.

One feature in the development of scientific methods is the establishment of technical libraries by textile mills, free access to the books being accorded the operatives. The latest and best works, on all subjects of interest and value to the mill, are placed before the operatives. Printed information regarding their work, coupled with explanations and diagrams, is welcomed by the workers, as the best way to make explanations clear is to give pictures or diagrams in connection with them.

Thus, when new problems are brought up for solution, the operatives have the advantage of being able to read up on the subject, and combine the knowledge thus obtained with their practical experience in the mill. When the heavy losses that frequently result from ignorance of some technical details of textile work are considered, it becomes evident that no textile mill can afford to neglect placing before its employees the best and latest books on textile manufacturing.

GLOSSARY OF TERMS USED IN THE PROCESSES OF WARPING, WINDING, QUILLING, ETC.

The writer, believing that it will be of interest and assistance to the reader, has carefully compiled the following list of the various terms most often used in connection with these processes.

Anchor Bobbin. A large bobbin having flanged heads, which are grooved to hold tension cords. Used to wind the edge or selvage upon.

Artificial Silk. A very lustrous, manufactured, textile fiber made from gummy solutions of cellulose expressed through capillaries into fine filaments which are subsequently solidified and combined.

Back Reed. A reed placed in a loom behind the regular reed and made of a frame carrying movable wires, or threads, which helps to separate the warp threads and to keep back lint, etc. (Also known as false reed.)

Ball Warps. Warps which, after being wound on the warping mill, are bunched together in rope shape and wound up in a ball, or similar form. Cotton warps are frequently handled in this way.

Band. The group, or series, of threads running from the creel, through the cross-reed and space-reed, and wound upon the reel. (See Section.)

Banking-up. Arranging, in their proper places, the bobbins on a warp creel. (See Tying-up.)

Beam. A cylindrical wooden roll, having an iron pin, or gudgeon, in each end. Used to wind the finished warp upon. Usually, on each end of a warp beam, is an iron head for tension ropes to ride upon, though many beams simply have grooved places cut in the wood. (See Flange-head Beam.)

Beam Apron. A coarse, strong cloth, one end of which is attached to the beam, the other end hemmed, and slit at intervals, and an iron rod passed through, to which the warp is tied for beaming.

Beamer. The operator of a beaming machine.

Beaming. The operation of unwinding a finished warp off from the reel onto a beam.

Beaming Machine. Strongly made, heavy, iron, power-driven machine, used for beaming warps.

Beaming Paper. A strong, heavy paper used in beaming to protect and hold in place, the warp on the beam. Sheets of it are wound on with the warp as the beaming proceeds.

Beam Rack. A strong frame of iron, or wood, in which to keep empty beams and beams containing finished warps.

Beam Truck. A small, low, heavy, two-wheeled truck, V-shaped at top, on which warps ready for weaving are wheeled to the looms.

Bearing. A support for shafts, spindles, swifts, etc.

Belt Shifter. A fork-shaped iron, attached to a machine, to move the driving belt from one pulley to another, to start or stop a machine.

Board-filler. An employee, generally an experienced quiller, who fills the quill boards for weavers.

Bobbin. A cylindrical piece of wood, with a head on each end, bored through to receive an iron pin. Used to wind thread upon. Fiber head, and iron head, bobbins are largely used. (See Spool.)

Bobbin Pins. Rows of iron pins on the warping creel, and on doublers and other machines, to hold the bobbins while running.

Bobbin Stops for Winding Frame. Small, adjustable iron brackets, attached to a winding machine, directly under the spindles which sustain the bobbins. Used to automatically stop the bobbins when full.

Boiled-off Silk. Undyed thrown-silk with the gum boiled out.

Boiling-off. The removal of the natural gum from silk goods or yarns by boiling in soap and water. (Same as Degumming.)

Bone Pick. A tapered, smooth bone, about 3 to 5 inches long, used to separate sections and find lost ends while warping. (See Pick-bone.)

Book. Bales of Asiatic silks are made up of smaller parcels called books.

Box. Receptacle in a loom into which the shuttle enters when it crosses.

Box Loom. A loom with more than one box on one or both sides.

Brake Strap. A rope or strap, arranged with tension weight, to control and steady the reel while warping on the horizontal warping machine.

Bright Silk. A name applied to thrown silk completely boiled-off and dyed.

Bundle. Several rolls of yarn, each containing a number of skeins, tied together.

Carriage. The movable, sliding, frame or device on a warping machine, which carries the reeds and section rollers.

Carriage Table. The board which forms the bottom of the carriage.

Carriage Wire Hooks. Hooked, bent wires, attached to the carriage, for supporting threads while adjusting broken or lost threads.

Catch-cord. A strong cord used on the edges of the cloth while weaving, to prevent the filling from pulling in or cutting the edges.

Caterpillar. A thread, part of which breaks and curls around the unbroken part in the shape of a caterpillar, caused by a weak spot in the thread catching in a guider eye or reed.

Chain Warp. A warp which is unwound from the warping mill in rope form and then looped into chain form for convenience in shipping. Cotton warps are frequently handled in this way.

Chiffon Twist. Hard-twisted, single, raw-silk threads, having from about 50 to 100 turns of twist per inch, more or less, used for making chiffons, mousseline de soie, etc.

Chop. The mark used on an Asiatic silk to identify its quality.

Cleaning a Warp. See Picking.

Clean Warp. A warp well made and picked free of yarn imperfections.

Cocoon. The covering that the silk worm spins around itself, which, when unwound, becomes raw silk.

Color Number. Number used to distinguish a color. Each shade should have a name and number.

Comber Boards. Short and narrow perforated sections or pieces of hard board, or one long one, extending from one side of a Jacquard loom to the other. The object of the comber board is to spread and guide the harness threads, which pass through the holes in the board.

Compass. An instrument used to space off the sections for a warp.

Conditioning. The determination of the weight of silk, or other material, on the basis of its normal condition, i.e., absolutely dry weight, plus 11 per cent. for silk, and other percentages for other materials, representing their ordinary content of moisture. Also colloquially used to cover tests for boil-off, size, etc.

Cone Pulleys. Two pulleys, cone shaped, arranged so that the larger end of one is opposite the smaller end of the other. The belt is adjusted with the aid of a belt-shifter. Used to vary the speed of a machine.

Cop. A tapered paper tube, used in place of a quill, and the yarn on it. Some cops are of solid yarn without any tube.

Cop Shuttle. A shuttle with a largely recessed interior, and without spindle, for holding a cop built up solidly of yarn, used for weaving extra thick yarns.

Corkscrew-twist. Faulty twist in yarn, giving a corkscrew appearance, due to uneven tension in the threads twisted together, or marked unevenness in their size.

Cotton. The fiber produced by the cotton plant, the filaments grow-

ing out from the seeds, enclosed in the pods. After picking, the fibers are torn away from the seeds by the ginning process, the fiber being then known as lint cotton.

Cotton (Uplands). A staple variety of American cotton grown on the uplands of the seaboard states of the Atlantic Coast. The grade known as Middling Uplands is the standard for cotton quotations.

Cotton (Egyptian). Long, fine, silky, cotton grown in Egypt. Largely used in spinning counts between 1/80s. and 1/120s.

Cotton (Gulf or New Orleans). Fine, long stapled, cotton, grown in the Mississippi Valley.

Cotton (Peeler). A superior grade of Mississippi Valley cotton, named after a former cotton planter.

Cotton (Peruvian). Very rough feeling woolly cotton, produced in Peru, which grows upon trees. Largely used for mixing with wool. (Also called tree cotton.)

Cotton (Sea Island). Very long-stapled extra fine, superior, cotton grown on the islands along the sea-coasts of South Carolina, Georgia, and Florida. The South Carolina Sea Island cotton is much the better and has no superior.

Cotton (Carded). Cotton prepared for spinning by the carding process.

Cotton (Combed). Cotton which has been first carded, and then combed, being straighter and cleaner than if only carded.

Cotton Yarn Count. This is based on the number of 840-yard skeins to the pound. No. 1 = 840 yards per pound. No. 2 = 1680 yards, etc., 2/40s = 1/20s; and so on, for other counts.

Count of Yarn. The number of a yarn indicating its size, from which its length per pound can be ascertained.

Creel. A frame of iron, or part iron and part wood, containing rows of iron pins. A glass bar reed extends across the top. Used to hold the bobbins for warping.

Crêpe de Chine Twist. Hard-twisted tram, in both right and left-hand twist, usually from 40 to 70 turns per inch, and generally made from three to five raw-silk ends, used for the filling of Crêpe de Chine.

Crêpe Georgette Twist. Generally made of two threads of 13/15 denier raw silk, with 50 to 90 turns per inch, right and left-hand twist, used for both warp and filling of crêpe georgette.

Crêpe Twist. Hard-twisted tram, 30 to 100 turns of twist per inch, more or less, used for the making of crêpey fabrics.

Cross. See Lease.

Cross Bars. Round steel bars, used to make and keep the cross while running on a Swiss warping machine.

Cross Cord. Strong, smooth cord used to keep the cross in a warp. (See Cross.) (See Lease Cord.)

Crossed End. An end that is not in its allotted place in the cross.

Crossing Sticks. Very smooth, hard wood rods, passed between the ends of all weaving warps for maintaining the cross. (See Lease.)

Cross Reed. A reed used to form the cross. One dent is partially closed in two places, about one-third the distance from each end of the dent. The next dent is open. These open and closed dents alternate singly, or in two, three, four, or irregular, manner according to the requirements.

One open, one closed = single-cross;
Two open, two closed = double-cross;
Three open, three closed = triple-cross;
Four open, four closed = quadruple-cross;
One open, two closed = } single-and-double
Two open, one closed = } cross, etc. (See Lease.)

Cross Reeled. Skeins wound with a quick to-and-fro movement of the guide eye, which lays the threads across each other at a sharp angle thus facilitating the winding. (See Grant Reel.)

Cross Rods. Hard-wood rods, used to make the cross on the horizontal warping machine.

Cut. The length at which a piece of woven cloth is cut off. Most usual length of broad-silk cuts, 60 yards, ribbons, 10 yards.

Cut Down (or Cutting Down). Term used when the number of bobbins is gradually decreased while warping.

Cut Marks. Marks either painted or tied onto a section of a warp at designated intervals, for the use of the weaver, who cuts off the woven pieces at these marks.

Degumming. See Boiling-off.

Denier. A weight equal to 1/20 gramme; used in determining the size, or count, of raw silk. The number of deniers which it takes to balance the weight of a reeling of the silk 450 meters long, is the denier, or size, of that silk. Dividing 4,464,528 by any denierage gives its yardage per pound. Dividing it by the yardage per pound gives the denierage.

Dent. The space between two wires of a reed. Properly, the wire itself. The number to the inch indicates the count of the reed.

Dial. An indicator on warping machines for measuring the length of the warp.

Direct Warping Machine. A machine used for making ribbon warps direct from the creel, through the cross-reed and space-reed, onto the beam.

Disk Pulley. A leather-covered shifting pulley, driving against the face of a disk for securing variable speeds.

Disposition. The written order for the working plan or arrangement of the threads in a warp.

Double-and-twist. Threads of different color or character doubled together and then twisted.

Doubling. See Doubling Machine.

Doubling Machine. Machine used to wind two or more ends from two or more bobbins onto one bobbin, to make a doubled or heavier end.

Doup. A half heddle which twists one of the pair of warp ends round the other in grenadine- or leno-weaving.

Doup Bobbin. A small bobbin with grooved head for tension weights used to wind binder threads on.

Dram. A weight equal to $\frac{1}{16}$ of an ounce, Av., used in determining the size, or count of thrown silk, based on the weight in drams of 1000 yards. A 1-dram silk has 256,000 yards per pound, 2 dram silk = 128,000 yards per pound, and so on. Dividing 256,000 by any dramage gives its yardage per pound. Dividing it by the yardage per pound gives the dramage.

Drawing-in. The drawing of the warp ends, individually, through the eyes in the heddles of the harness. (Also known as Entering.)

Drawing-in Frame. A framework support for the warp and its set of harness, used while the warp ends are being drawn through the harness.

Draw-side. A machine used for winding from one bobbin to another. Doubling and winding machines can be used for this purpose. Also known as a Transferring Frame.

Dyeing. The coloring of silk (or other material) including the boiling-off, weighting, coloring, and other processes.

Dye Lot Ticket. A tag, or ticket, containing a record of the details concerning the dyeing of a lot of yarn.

Dyer. One who dyes or colors yarn, or other material.

Dynamited Silk. A current expression for silk weighted with tin salts, owing to the destructive effects sometimes experienced.

Écru Silk. Thrown silk from which very little (say 3 per cent, more or less) of the gum has been discharged, leaving it harsh and lusterless.

Edge Machine. A machine for the purpose of making edges directly onto the anchor bobbins.

Edges. A number of threads specially arranged, generally double or triple, to be placed on both sides of the warp, to strengthen and protect the edges of the woven cloth. Sometimes made on the beam with the warp and sometimes wound on separate bobbins.

Elevation Irons. The adjustable, flat, iron bars attached lengthwise to each slat on the reel of a Swiss warping machine. Used to keep the warp level. Also known as grade-bars.

End. A term applied to any thread used in textile work, more particularly applied to a warp thread.

End-and-End. Alternating threads in a warp of different colors or kinds.

Endy Skeins. Skeins in which a number of threads have been broken so that there are loose projecting ends here and there, thus increasing the difficulty of winding.

Entering. See Drawing-in.

English Harness. A harness, the heddles of which are made of threads with mails, or metal eyes, in the center, or with eyes made in the threads themselves. Frequently stiffened by oil-coating and baking, then being known as baked harness.

English Quill. A quill bored entirely through, such as is used on an English Quiller.

English Quiller. A quilling machine in which the quills are held in a vertical position with their points downward, and supported by revolving cones, between which the spindle passes.

Expanding Swift. A wooden winder swift with a bevel gear hub, meshing in with bevel gears at the foot of each arm. According to the way the hub is turned, the arms will work out, or in, thus changing the outer circumference.

Eye Shade. A flexible shield used to protect the eyes from strong, glaring light.

Faller Wires. Light wires connected with the stop-motions on doubling machines, reels, etc., through the eyes of which the moving threads pass, and which support the wires in position. When a thread breaks, the wire supported by it falls, and in so doing actuates the stop-motion mechanism and stops the spindle.

False Reed. See Back Reed.

Fancy Stripes. Any warp made in a stripe effect, either with various colors or one color, specially spaced or arranged. (See Stripe Warp.)

Filling. The threads running crosswise in cloth. Same as Weft.

Fine End. A silk thread that is too thin in places, caused by faulty raw-silk reeling.

Flake Yarn. A fancy yarn, usually with a cotton foundation, showing flakes, or slugs, of untwisted fibers at intervals.

Flange-head Beam. A beam having an adjustable disk, or flange, on each side, for beaming warps without the use of paper.

Flat. An imperfection in the cross, where an end is either left out, or

the cross improperly taken, with an uneven number of ends, bringing two ends in the same cross, instead of one up and one down.

Float. An imperfection in the cloth, where the filling crosses—or floats—over warp ends which it should pass under.

Floss Silk. A soft silk yarn, practically without twist, used for embroidering. Also waste silk thrown off by the worm before beginning its cocoon.

Flyer. A small iron weight, fitted with a wire swivel-guide and short pin, to place on an upright bobbin of doubled threads, to twist and guide the thread while winding onto the quill. Also a bent-wire guide used on a spinning spindle.

French Harness. A harness made with top and bottom wooden slats, and looped threads between, two pairs of looped threads acting as one heddle. As it wears, the position of the threads can be changed, thus affording an unworn surface for contact with the warp. This " turning " can be done several times, thus lengthening its life. It is an excellent harness for dyed silk warps.

French Quill. A quill which is only bored through a portion of its length, the point being solid.

French Quiller. A machine for quill winding, the spindles being arranged in a horizontal position, and on which French quills are used.

Friction-drive Pulley. A loose pulley which is operated by a clutch, running against the driving pulley. Used for starting or stopping a machine.

Glass Reed. A reed made of glass, with a wooden frame, mounted on top of the warp bobbin creel.

Glass-reed Bars. Long, heavy round-glass rods, fixed at the bottom of the glass reeds.

Glass-reed Dents. Small, rod-shaped, pieces of glass, used to form the reed on top of the creel.

Grant Reel. A reel arranged with a guide traversing quickly back and forth, thus forming a skein with the threads crossing each other at sharp angles, greatly facilitating winding. Named after its inventor, and now universally used. (See Cross Reeled.)

Grenadine. An open-mesh silk dress fabric, in which the warp ends twist round the filling picks, thus preventing slippage.

Grenadine Twist. Hard twisted organzine suitable for the warp of Grenadines, which must stand severe friction. Usual twists run between the limits of 20/18 and 60/60 turns per inch.

Grooved Pulley. A narrow-faced, grooved, pulley driven by a twisted belt, or a round belt.

Guard String. A cord tied from the carriage to the creel on each side of the section to protect the ends when warping.

Guiders. Small, porcelain, glass, or enamel guides, of various shapes, used on all winding, quilling and doubling machines, to guide the threads on the bobbins or quills.

Guider Rail. A thin, wooden, rail, the length of the winding machine, riding upon small rollers, carrying the guiders, and traversing back and forth to spread the threads onto the bobbins.

Gum Silk. Thrown silk from which the gum has not been boiled-off.

Hairy Yarn. A thread that appears to be covered with hair. Canton silks are usually hairy.

Hard Silk. Silk from which the natural gum has not been removed.

Hard Twist. See Crêpe de Chine Twist, Crêpe Twist, etc.

Harness. A mechanism of the loom for causing the warp threads to open in a prearranged manner. Consists of a series of light wooden frames surrounding the warp, equipped with thread, or wire, heddles, running vertically from bottom to top within the frames, and with an eye in the center of each heddle. There are as many frames as are required by the weave, and a heddle for each warp thread. The alternate rising and falling of the harnesses in the orderly separation of the warp threads, with the filling picks passing between them, creates the weave of a cloth. Jacquard harnesses are differently arranged.

Harness Building Machine. An automatic machine for building thread harnesses, French or English. Can build them plain or spaced.

Harness Loom. See description under Harness. Same as Shaft Loom.

Harness-skips. A row of floating warp threads across a piece of cloth, where the warp ends have not been caught and bound down, as they should, by the filling pick.

Head Ends. Same as Headings.

Headings. The beginning and ending of a piece of cloth, generally woven with some remnant material for filling.

Heavy Warp. A warp containing a great number of ends; a very long warp; a warp of very coarse yarn.

Heddle. See description under Harness.

Horizontal Direct Warping Machine. One upon which the sections are wound straight.

Horizontal Swiss-motion Warping Machine. One that winds the sections with a traverse motion.

Jack-roll. A cylindrical wooden beam, having flat, large heads, with an iron pin in each end. Used to wind the doup warp upon for grenadine.

Jacquard Machine. A machine, named after its inventor, for raising and lowering the harness threads in a loom, each thread having its indi-

vidual heddle. By its use, figured patterns of large size can be made, as against the very small patterns which the harness loom can make.

Kinked Yarn. A thread which kinks or snarls.

Kneeboard. A narrow board across the full length of a winding machine, in front, to protect the swifts.

Lace Cord. A smooth, heavy, braided cotton cord in which the fibers of the silk cannot catch, used for lease cords, tying skeins in bundles, etc.

Laces. The tie bands or separations in skeins made from suitably twisted cotton yarns.

Lapped Sections. Part of one section lapped over another, caused by inaccurate spacing while warping.

Lathe, or Lay. The strong, wooden beam, across the front of a loom, containing the reed, shuttle boxes and shuttle race. It moves forward to allow the reed to beat the filling into place while weaving, then back.

Lease. The passing between the threads of a warp, of cords, or sticks, above and below which the threads cross alternately. Also known as the Cross.

Lease Cord. See Cross Cord.

Light Warp. A warp consisting of a small number of ends; a short warp; a warp made of fine yarn.

Lingo. A thin wire having an eye at one end; used as a weight on the end of each Jacquard harness thread.

Lint. The fine, dustlike, fibrous particles which come from yarn. They fly around in the air and, if colored, may cause imperfections in white work.

Long End. An end which is found to be one or more rounds of the reel longer than the rest of the warp when beamed. Due to imperfect warping or beaming.

Long Section. A section which is one or more rounds of the reel longer than the rest of the warp when beamed. Due to an error on the part of the operative.

Loom. A machine for weaving cloth.

Loom Mounting. Disposing a drawn-in warp, with its harness and reed, in a loom, preparatory to weaving.

Lot. Term used for a quantity of yarn.

Lot Ticket. A tag or card containing the necessary details concerning a lot of yarn.

Lousy Silk. Silk which exhibits many small light-colored specks on its surface, principally due to the splitting and curling up of fine fibers.

Lumps. Any waste, slugs, or other heavy yarn imperfections.

Mail. A small metal eye, used in the heddle of a Jacquard or other harness thread, to pass the warp thread through.

Mercerized Cotton. Cotton yarn (or fabric) which, after being treated with cold caustic soda solution while under tension, and then washed, acquires a silky appearance in the process. Called after Mercer, who introduced the method.

Meter. A linear measure = 39.37 + inches, upon which the Metric System is based. Generally, but inaccurately, figured as 10 per cent more than one yard in textile calculating.

Metric Count. A No. 1 yarn weighs 1 gramme for 1 meter = 1 Kg. for a thousand meters. No. 100 weighs 1 Kg. for 100,000 meters, etc. (See Meter.)

Mispick. A pick, or part of a pick, left out of the cloth, due to breakage, or quill becoming empty.

Mixed Fabric. A fabric constructed of materials of different kinds, as silk and cotton.

Neck Cord. A short and strong cord, looped at the ends, connecting the hooks on a Jacquard machine with the harness threads.

Ombré. Shaded; graduated in shade, or color.

Ombré Warp. A warp containing a series of shades of a color or colors, shaded from light to dark, or vice versa.

One Beam Warp. A warp, the whole of which is contained on one beam.

Operative. One who operates, or runs a machine.

Organzine. Silk specially twisted for use as warp. Two (or more) raw-silk threads, which have been well twisted in the single, are doubled and then twisted the reverse way; 16 turns in the first time twisting, and 14 turns reverse twist, is the most usual arrangement.

Paraffine. A species of wax used to facilitate the working of yarns.

Parting Stick. A wooden rod used for parting, pulling and dressing skeins on, for improving their winding qualities.

Pattern. A design, or arrangement of figures, stripes, checks, etc., for fabrics.

Pattern Warp. Same as Sample Blanket.

Picks. See Filling.

Pick-bone. See Bone Pick.

Picking. Removing odd threads, lumps or similar blemishes from warps and woven fabrics. The movement of a loom as it drives the shuttle across. In the spinning of cotton, wool, etc., a preliminary opening up given to the stock in preparation for carding.

Picking Tongs. An implement used in picking the imperfections from silk fabrics, having a needle point at one end, and a pair of clipping jaws at the other.

Piece. A length of goods. Standard lengths of broad silks for the

various trades and fabrics are 40, 60, 75 and 100 yards, 60 being the most common. Ribbons come in 10-yard pieces.

Piecing Bobbin. A partially-filled bobbin of yarn, the same as used in the warp, used for piecing or tying broken ends in warping or weaving.

Pigtails. Metal, or porcelain guide eyes, with the ends curling round once or twice in a circle.

Pin Axle. Small iron pin fitted on each side of a winding swift hub.

Pin Cops. Cops of yarn, almost solid, with a short paper tube at the base as a guide to the spindle, which is forced through the rest of the cop. Also applied generally to small-sized cops.

Pipe Creel. A creel made of iron piping. The pin rails are adjustable and made of iron bars attached to the pipe frame with sockets and set screws.

Plain Warp. One made with one kind and color of yarn.

Pure Dye. Silk colored, but not weighted.

Quill. A tapered wooden cylinder, bored lengthwise through the center to fit onto spindles while winding the yarn from bobbins. Used in the shuttle at the loom, to supply the filling.

Quill-board. A board containing rows of pins on which quills are placed to carry them to the loom.

Quilling. The operation of winding onto quills. (See Spooling.)

Quilling Machine. A machine used for winding yarn from bobbins onto quills, cops or tubes. See English Quiller and French Quiller.

Raw Silk. Silk in thread form, as it has been unwound from the cocoons, the thread being composed of several cocoon filaments.

Raw Silk Count. See Denier.

Re-drawing. (Also called **Back-winding** or **Transferring.**) The unwinding of wound threads from one bobbin and re-winding them onto another. Useful in regularizing the tension.

Reed. A series of flat metal blades, or thin wires, arranged like the teeth of a comb, and held in place at both top and bottom. Used to keep the ends separate and in their proper places while warping and weaving. The main function of a loom reed is to beat up the filling picks into the cloth.

Reed-frame. A wooden frame for holding a reed.

Reed-holder. A wire, hook shaped at each end, used to support the reed on the creel while reeding.

Reed-hook. A thin metal-blade, hook shaped at one end, the other inserted in a handle. Used to pull the ends through the reed.

Reeding. The operation of putting the warp ends through the reed in their designated order. Also called "sticking the reed." Also called "Sleying."

Reeding Knives. Small, thin, flat strips of metal, hard-wood, or bone—usually the latter—about $3\frac{1}{2}$ inches long by $\frac{5}{8}$ inch wide, notched near the ends, used in drawing the warp threads through the dents of the reed, the process being called " reeding " or " sticking the reed." Two are used at a time, being passed through each dent alternately, the one in the dent acting as a guide for the other when it is put through the following dent. Coarser or finer " knives " will be used according to the spacings of the reed.

Reed Ombré. A shaded, or ombré effect, produced in cloth, warp ways, by the irregular spacing of the warp through the reed, putting more threads in some dents, and fewer in others.

Reel. A cylindrical frame upon which warps are wound. There is also a reel used for winding skeins.

Reeler. The operative who runs a yarn reel.

Reeling. The operation of unwinding the silk from cocoons to form raw silk. The winding of yarn from bobbins into skein form.

Remnants. Small quantities of yarn, woven cloth, etc., left over.

Rings (in raw silk). Places where the thread in raw-silk reeling has escaped from the traverse guide, and has revolved for some distance in a ring instead of in its usual crossed form. Increases the difficulty and the waste in winding.

Ringer. An end which breaks while warping or beaming and remains on the reel after the warp is beamed off.

Roll (of yarn). A number of skeins made up into a roll.

Sample Blanket. A short length of goods made for samples, having sections of different colors in the warp, and shot with a variety of different fillings. (Same as Pattern Warp.)

Schappe. Spun-silk yarn, more particularly, when made from stock which has been degummed by the schapping, or maceration process. (See Spun Silk.)

Scroop. A creaking or crunching sound which silk makes when squeezed or twisted. It can be artificially produced by special treatments.

Section. See Band.

Section Hooks. Small wire hooks, used for short warps, to hook the end of the finished sections upon.

Section Marks. Streaks in cloth which are caused by faulty spacing, or uneven tension, of the sections in warping.

Section Pins. A row of small pins inserted into one of the slats on the reel of a warping machine upon which the sections are hooked when starting.

Selvage. See Edges.

Shaft Loom. Same as Harness Loom.

Shed. A term applied to the space created when part of the ends in a warp are lifted and the remainder left in place. When weaving, every pick, or shot, of the shuttle goes through the shed thus made by the pattern mechanism.

Short End. An end broken, or lost, while warping, and which, when found and repaired, is one or more rounds of the reel too short.

Short Section. A section which, through an error of the warper, is found to be one or more rounds of the reel shorter than the rest, when the warp is beamed.

Shuttle. A wooden, steel-tipped, carrier for the filling, used on the loom to shoot the filling into the cloth.

Silk. A fine, lustrous, thread, produced from the cocoon of a silk worm.

Silk Reeling. See Reeling.

Silk Waste. Wastage is made in all operations of manipulating silk. The wastes made in the silk-reeling and silk-throwing processes, including the pierced cocoons, are the materials from which spun silk is made. (See Waste.)

Single-and-double Warps. Warps made with a variation of threads, giving two ends for the face to one on the back, or vice versa.

Singles. Name applied to thrown silk where single threads only have been twisted, as used for Chiffon, etc. Also applied to raw-silk threads when used as warp. (See Chiffon Twist.)

Single Weaving. Weaving of fabrics made with raw-silk warps, such as cotton-back satins, etc.

Size. The term used to designate the thickness and weight of a yarn. Same as the Count.

Sizing. The treatment of fabrics, or of yarns, with a dressing, or sizing to render them smooth and firm. Also, the weighing of sample lengths of yarns to determine their count.

Skein. A hank of yarn; the circumference, for silk being usually 45 to 54 inches.

Skein Dressing Pole. A strong, short pole, horizontally attached to a standard, or to the wall, for spreading, dressing, and parting the skeins to clear them preparatory to winding.

Skein Dyeing. The degumming, weighting, dyeing, etc., of silk, or other yarns, in the skein.

Skinny Bobbins. Bobbins upon which only a small amount of yarn has been wound.

Slat. One of the horizontal wooden slats on a warping reel. (See Stave.)

Sleeper. An end which breaks and stops at the reed, but does not curl or snarl and does not run with the other ends.

Slubs. Soft, irregular, lumps found in yarn. Same as Slugs.

Slugs. Soft, thick, lumpy places in a yarn. Same as Slubs.

Smash. A place where a large number of warp threads have been broken, due to the loom beating up and catching the shuttle in the shed before it has passed through. Also, applied to similar breakage of warp threads in warping.

Soaking. A treatment accorded to raw silk, as a preliminary to throwing, where the silk is immersed for some hours in a bath of tepid water containing an emulsion of soap and oil, much of which the silk takes up and retains.

Soft End. In a yarn that is twisted, an end that is without twist in places.

Soft Silk. Thrown silk yarn from which the gum has been discharged, undyed or dyed.

Souple Silk. Skein-dyed silk from which only about half the gum has been removed in the boiling-off. It is duller looking and firmer than silk completely degummed.

Spaced Harness. A harness built with alternate spaces between the heddles for use in weaving striped warps.

Space-reed. A reed used for spacing and guiding the section while warping.

Speed (of a pulley or machine). The number of revolutions during a given period of time.

Spindle. An iron or wooden pin, or small bar. Also, a pin having a small pulley head on one end, and a spring affixed lengthwise, for holding the bobbin while winding. Also a revolving tapered spindle for spinning.

Spinning. The twisting of textile fibers-cotton, wool, spun silk, etc., to make them hold together and form a yarn. Also applied to the twisting of silk in the throwing process. Sometimes applied to the unwinding of the raw silk from the cocoons.

Split End. A thread in which one of the sub-threads, composing it breaks, making a serious defect.

Spool. See Bobbin.

Spooling. See Quilling.

Spun-silk Count. Same as Cotton Yarn Count, except that two (or more) ply yarns are stated differently. In spun silks, 60/1, 60/2, 60/3, 60/4, etc., will each be a yarn counting 60×840 yards $= 50{,}400$ yards per pound, made up of 1, 2, 3, or 4 threads, respectively. On the Continent, spun silk, or schappe, is numbered by the metric system.

Standard. Term applied for the warp thread around which the doup thread twists in grenadines.

Stave. See Slat.

Step Cone Pulley. A pulley consisting of a series of steps. Used for changing the speed of a machine.

Sticky Ends. Fine fibers on the threads, atmospheric conditions, dyeing treatment, or poor tension, sometimes cause the ends to cling together, and they are then termed sticky.

Stop Motion. A device to automatically stop a machine or part of a machine.

Straight Reeled. Skeins reeled without the use of a traverse motion, or with a slow-moving traverse, as distinguished from cross-reeled, in which a quick-moving traverse is used.

Streaky Warp. Streaks or defects lengthwise of the warp.

Stripe Warp. See Fancy Stripes.

Swift. A skeleton frame reel, consisting of a hub, with a pin on each side for axles, and having a double row of tapered spokes. Used for holding and spreading the skein while winding.

Swift Spokes (or sticks). Thin, tapered wooden sticks, used as spokes in winder swifts.

Swiss Motion. So far as can be ascertained, this is an old Swiss invention, used on warping machines, to build up sections, gradually inclining, on the elevation-irons so that each consecutive round overlaps the preceding one, the overlapping part at the beginning of the warp, resting on the elevation-irons. In this way, warps can be made of any desired length without the use of guides, or flanges, which otherwise would be needed to prevent the ends at the edges of each section from moving out of place, thereby making their tensions irregular, a defect that is bound to cause endless trouble. Any number of sections may be made in this way, with all the threads level and in place, and held at equal tension, until the necessary width of the warp has been attained, each section being an exact repetition of the first. When the warp, which has thus been built up in sections, is finished, it is beamed off as a whole in one operation, and this applies to warps made on large reels as well as those made on small reels.

Swiss Warping Machine. One with Swiss motion, smaller, and differently constructed than a horizontal machine.

Take-off Machine. A small, portable, hand-power machine, used to wind edges onto bobbins.

Tension. Weight or tightness.

Tension Strap. A band of iron, generally leather-lined, used to apply tension with weights, while beaming a warp.

Tension Weights. Iron weights of various sizes, used to take up the slack, and keep tight the threads, while winding, warping or weaving.

Textile Mill. A mill conducting any of the processes incident to the fabrication of textiles.

Thread Finishing. The sizing, or dressing of individual threads of yarn to impart smoothness and firmness.

Throwing. The combining and twisting of raw-silk threads in various ways, thus making it practicable to dye them in the skein.

Thrown-silk Count. See Dram.

Throwster. One who conducts a silk-throwing business. This work is largely done on commission.

Thrum. The end of a warp where the threads are knotted together.

Tram. Raw-silk threads doubled together and twisted, usually about two to five turns per inch, used for filling.

Traverse. A device used on reels, winders, quillers, etc., which automatically shifts, to and fro, the thread which is being wound, and so spreads it evenly from side to side of the skein, bobbin or quill.

Twisting. The uniting of the threads of a new warp to those of one woven out, by twisting the threads together. Also applied to the putting in of the second-time twist in throwing. Also to the twisting together of two or more single threads to make a ply yarn.

Twisting-in Frame. A framework in which is placed a warp, on its beam, ready to be twisted, as well as the old warp, and its beam, to which the new one is to be twisted.

Twisting-in Machine. A machine which performs the twisting-in process mechanically.

Twist Tester. A mechanical contrivance for determining the amount of twist in sample lengths of yarn which are being tested.

Two-beam Work. Fabrics which require two warps mounted on separate beams, for their production. Three beams, and even more, have sometimes to be used.

Tying-up. See Banking Up.

Warp. The threads running lengthwise in cloth.

Warp Beam. See Beam.

Warping. The process of making a warp.

Warping Machine. See Horizontal Warping Machine. See Swiss Warping Machine.

Warp Order Ticket. A printed form containing the plan and arrangement of a warp, showing how it is to be made.

Warp Picking Frame. A frame upon which a warp may be stretched out for picking and cleaning, the warp unwinding from one side of the

frame, and being rewound on a beam at the other side. It may be operated by hand or by power.

Warp Print. A pattern printed on a warp before it is woven.

Waste. Cuttings, pickings, damaged yarn, etc., made during the various processes of textile manufacture. (See Silk Waste.)

Weave. Interlacing of the warp and filling threads to form a fabric. Construction of a cloth.

Weft. See Filling.

Weighted Silk. Silk which has been increased in weight and bulk by the addition of adulterants.

Winding. The process of transferring yarn from skeins onto bobbins.

Woolen Yarn. Yarn made from carded wool.

Woolen Yarn Count. The Philadelphia count is based on the cut of 300 yards to the number, 1 cut being 300 yards per pound, 10 cut, 3000 yards, etc. The New England count is based on the run of 1600 yards to the number, 1 run being 1600 yards per pound, 5 run, 8000 yards per pound, etc.

Worm Screw. A long steel bar with a screw thread, which controls the traverse motion on a Swiss-motion warp machine.

Worsted Yarn. A woolen yarn, which, before spinning, has been straightened, leveled, and cleaned by the combing process. Made from wool specially selected for the purpose.

Worsted Count. This is based on the number of 560-yard skeins to the pound. No. 1 is 560 yards per pound, No. 2, 1120 yards. 2/40s = 1/20s = 11,200 yards per pound.

Yarn. Any kind of thread intended for weaving which has been spun and twisted.

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